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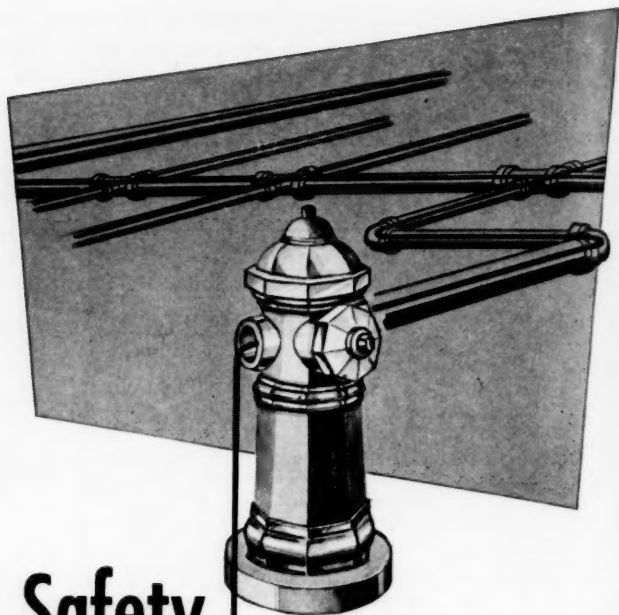
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Vol. 37

May 1945

No. 5

## **The American Water Works & Electric Company's Policy Concerning Cross-Connections**

*By John H. Murdoch Jr.*

Attorney, American Water Works & Elec. Co., New York, N.Y.

A contribution to the Journal

### **EDITORIAL NOTE**

THE American Water Works Association makes available to the readers of its JOURNAL this constructive evidence of the desire of the country's largest private water utility to control effectively the connections to its mains which have been made by customers who have felt that private and often unsatisfactory water supplies should be used by them within their own properties without restraint. In view of all the consideration which has been given in recent years to dangers existing within the properties of water users who are not properly concerned with safe plumbing and safe water, it is gratifying to publish the following statement of policy. It is certain that it marks an historic step in American water works practice.

### **A POLICY CONCERNING CROSS-CONNECTIONS**

THE American Water Works and Electric Company controls and operates 75 water works companies serving more than 100 communities. At the end of 1944, the various water works properties of the company served 703,881 customers or approximately 3,000,000 persons in 21 states and Cuba.

During 1944, the president of the company, E. S. Thompson, having in mind the consideration which was being given by the water works field to the control of cross-connections on customers' properties, appointed a special committee to study the practices followed by the various operating water companies in the system regarding

cross-connections and to recommend such changes as the committee thought to be needed. This committee consisted of: F. R. Berry, Assistant Chief Engineer; D. C. Morrow, Operating Group; C. E. Trowbridge, Sanitary Engineer; and John H. Murdoch Jr., Counsel.

The recommendations of this committee were embodied in a series of proposed rules and customers' contracts which appear hereinafter. It will be understood that the word "customer" used in this discussion means a person or corporation which has a contract for water service and pays the bills which accrue. A "consumer" is any person who may have access to the water supply on a customer's property, but may or may not be a customer. In the ordinary American city the customer-consumer ratio is about 1 to 4.

Portions of the report of the special committee to President Thompson follow:

"The committee feels that all cross-connections between a company supply and a second supply, other than an approved source of *public* water supply for potable water, are potential hazards and that the company should not permit any such cross-connections to be created in the future. All such cross-connections, not in the excepted class, should, we believe, be classed as "objectionable." We would prefer that the companies not have any objectionable cross-connections but we recognize that many are now in existence which do not constitute any substantial threat to public health and that, from a public relations standpoint, it would be disastrous to insist on the elimination of all such cross-connections at once. We have, therefore, recom-

mended that some otherwise "objectionable cross-connections" be put in a special class as "tolerated cross-connections" if they meet the required tests. The toleration would, in all cases, be temporary and renewable for one-year periods only. Toleration would be given only by the manager on the recommendation of the sanitary engineer after personal inspection or, in the alternative, on written authority from the president of the company.

"Our thought in so limiting continued toleration was to bring home to the operators of the water company the serious nature of the act of tolerating conditions which are generally accepted as constituting potential public health hazards and to pin down to specific individuals the responsibility for such act. In practice it is our thought that service will not be refused to any consumer because of the continued existence of cross-connections installed prior to the effective date of the new rules and regulations, without an order from the president of the company. This is to prevent serious disputes with consumers in cases where the sanitary engineer or the manager refuses to recommend or give permission for the continuance of service. In such a case the service could be continued on a temporary basis if the president of the company would, in writing, assume the responsibility.

"As to interconnections, it is our thought that we should assume no responsibility beyond retaining the right of cutting off service on order of health authorities because of the existence of dangerous interconnections. The water company cannot know of all such connections and we do not believe it should prohibit conditions over which it can exercise no adequate supervision.



"We believe that a water company is liable for damages caused by its failure to prevent or eliminate dangerous conditions of which it has knowledge or of which, by the exercise of reasonable diligence, it should have had knowledge. As a matter of cold fact, we do have knowledge of many cross-connections so that we are responsible in law. It is our thought that we should limit our risks by forbidding new cross-connections while, at the same time, we go on record through written permits covering the cross-connections which we will tolerate for continuance. We would require the customer to call existing cross-connections to the attention of the company and assume rather heavy responsibilities to the water company if the service be continued. Our responsibility to third persons cannot be passed on to the customer but we believe the customer should be made to realize the risks involved and that he assumes those risks and will be held responsible to the water company.

"We know that cross-connections can be installed without the knowledge of the water company and that cross-connections may continue in existence for long periods without being detected. Under such circumstances the water company is not legally responsible. On the other hand, we believe that the company should take responsibility for conditions of which it has either actual or constructive knowledge. We want the public to believe that we do all we can within reason to deliver—not merely produce at our plant—a safe, potable water supply."

The committee's recommendations have been accepted by the management of the company and the following procedure is now under way:

1. In each state in which the company operates one or more water works properties, the state sanitary engineer has been or will be advised fully concerning the intended policy.

2. The manager of each company in the system will be directed to establish legally the "Supplemental Rules and Regulations Concerning Cross-Connections." This may involve approval by a public service commission and/or acceptance by the public authorities in each city or town where service is rendered.

3. The sanitary engineering department of the company is charged with the duty of explaining the company's position regarding cross-connections to the various health authorities and to the public utility commissions as well as facilitating their approval of the policy.

4. Through the contacts of the company's sanitary engineering department, as well as through the printed word in the company's employee magazine, *Water*, the entire responsible personnel of the company's various properties will be brought to understand the policy to the end that it becomes effective and that cross-connections in any city where the company renders service will be as thoroughly controlled as the good intentions and management practices of the company can make them.

**SUPPLEMENT TO RULES AND REGULATIONS TO COVER CROSS-CONNECTIONS AND INTERCONNECTIONS****Preamble***Reason for Rules and Regulations Concerning Cross-Connections and Interconnections and Methods of Enforcement*

The company accepts the judgment of various public health authorities that all connections or plumbing arrangements which would or might permit water from other sources than the system of the company, or pollution or contamination from any source, to be drawn or admitted into lines carrying potable water furnished by the company, constitute hazards to public health unless the connection be with a second source of supply which also is an approved, acceptable, safe and sanitary source of public water supply. Even such an approved second source of supply should not be cross-connected with the supply from the company lines unless such connection be approved by the health authorities and the company.

The guarding of the potable water supply from or in the lines of the company from possible contamination through objectionable connections on customers' premises and outside of company-owned facilities depends, primarily, on the good sense, good faith and co-operation of the company's customers, and next, upon vigorous action and co-operation from plumbing inspectors and public health officials. The company, through the adoption of these Rules and Regulations and by continued enforcement of them to the extent of its ability, co-operates with customers and with public officials in lessening the chances of contamination through objectionable connections.

**Rules and Regulations Concerning Cross-Connections and Interconnections****I. Definitions**

When used in these Rules and Regulations the following words and phrases shall have the meanings herein provided:

(a) *Cross-Connection.* A cross-connection is any pipe, valve or other arrangement or device connecting the pipelines of the company or facilities directly or indirectly connected therewith to and with pipes or fixtures supplied with water from any source other than the lines of the company directly connected.

(b) *Interconnection.* An interconnection is a plumbing arrangement, other than a cross-connection, by which contamination might be admitted or drawn into the distribution system of the company, or into lines connected therewith, used for the conveyance of potable water.

(c) *Acceptable Cross-Connection.* An acceptable cross-connection is a cross-connection having all of the following characteristics:

1. The source of the supply other than the lines of the company directly connected is also a source approved by the State Department of Health as an acceptable, safe and sanitary source of public water supply and which continues as such at all times while the cross-connection is in existence;

2. Installed or continued in existence with the knowledge and specific consent of the company, and when installed on the premises of a customer, or installed by a customer, such con-

sent to be evidenced by either: (A) communications on Forms 1, 2 and 3, set forth in Section V of these Rules and Regulations concerning cross-connections and interconnections; or (B) written authorization from the president of the company (not applicable to new installations).

3. Installed or continued in existence and operated at all times in strict compliance with all applicable laws, ordinances, rules and regulations.

(d) *Objectionable Cross-Connections.* An objectionable cross-connection is any cross-connection other than an "acceptable cross-connection."

(e) *Tolerated Cross-Connection.* A tolerated cross-connection is an objectionable cross-connection having all of the following special characteristics set forth in either (A) or (B):

(A) 1. Installed and in service before the .. day of .., 194..;

2. Called to the attention of the company by written application for Continuance of Water Service (Form 1) from the owner or occupant of the premises on which the cross-connection exists within ten days from the receipt by such owner or occupant of notice of the adoption of these Rules and Regulations;

3. Continued in existence on a provisional and temporary basis after the .. day of .., 194.., without discontinuance of water service on recommendation of a sanitary engineer for the company, evidenced by written communication to the manager of the company (Form 2), and with the consent of the company evidenced by written communication from the manager of the company (Form 3).

Or, in the alternative:

(B) 1. Installed and in service before the .. day of .., 194..;

2. Continued in existence on a provisional and temporary basis after the .. day of .., 194.., on the written authorization of the president of the company.

II. *Prohibition of Installation of Cross-Connections*

After the .. day of .., 194.., no cross-connection shall be installed or made unless such cross-connection shall be an "acceptable cross-connection," as defined in these Rules and Regulations, and the installing or making or the causing or permitting of the installing or making of a cross-connection, other than an "acceptable cross-connection," after the said .. day of .., 194.., shall constitute a violation of the Rules and Regulations of the company.

III. *Prohibition Against Continuance in Operation or Existence of Cross-Connections*

After the .. day of .., 194.., no cross-connection shall be continued in operation or existence unless such cross-connection has and continues to have at all times the special characteristics required to qualify it as either an "acceptable cross-connection" or a "tolerated cross-connection," as those terms are defined in these Rules and Regulations, and the causing or permitting by any customer or any owner or occupant of premises of the continuance in operation or existence of such cross-connection not in the excepted classes shall constitute a violation of the rules and regulations of the company.

IV. *Right of Company to Discontinue Water Service for Violations of Company Rules and Regulations Re-*

*garding Cross-Connections or on Order of Public Authorities*

In addition to any or all other grounds for discontinuance of service, the company shall have the right to discontinue water service on reasonable notice, not to exceed thirty days, under any of the following circumstances:

1. Violation by a customer or by a property owner or occupant of company Rules and Regulations regarding cross-connections;

2. Receipt by the company of an order from health authorities or plumbing inspectors to discontinue service to a premises on the ground of violation of company Rules and Regulations regarding cross-connections, or on the ground of dangers to health because of the existence of interconnections on the premises.

3. When the company has knowledge that health authorities or plumbing inspectors have ordered a cross-connection or interconnection, existing on the premises, to be discontinued or broken and such order has not been complied with.

*V. Forms for Use in Connection With These Rules and Regulations Concerning Cross-Connections and Interconnections*

FORM 1

APPLICATION FOR CONTINUANCE OF WATER SERVICE TO PREMISES ON WHICH CROSS-CONNECTION EXISTS

Dated ....., 194..

To ..... WATER COMPANY:

Applicant, ....., owner, occupant or water customer at the premises known and described as follows: ....

..... does hereby make application for continuance of water service at said

premises on which one or more cross-connections exist and makes representations and agrees and covenants as follows:

1. That the only cross-connections within the definition of that term in the Rules and Regulations of the water company, existing on the above designated premises on the date of this application ..... located and described as follows:

2. That the blueprint— or drawing— attached to and made a part of this application correctly and accurately portray the physical layout and details of construction of said cross-connection—

3. That the applicant is familiar with all applicable rules and regulations of state and local health authorities and with any applicable laws, ordinances, rules or regulations concerning plumbing, and represents that the aforesaid cross-connection— may be continued in existence after the date of this application without violating any such law, ordinance, rule or regulation.

4. That the applicant will at all times operate and maintain the aforesaid cross-connection— in full compliance with any such law, ordinance, rule or regulation as now in force, or as may hereafter be put in force by new enactment, promulgation, change, amendment or addition.

5. That the applicant will make no change in the structure, character or method of operation of the aforesaid cross-connection— or create or install any new cross-connection—, without prior specific and detailed written permission from the manager of the water company issued pursuant to written recommendation from a sanitary engineer of the water company.

6. That the applicant, for itself, its heirs, successors and assigns, hereby

gives and grants to the water company the right, by its officers or agents, to enter upon and into the aforesaid premises at any reasonable time to observe and inspect the aforesaid cross-connection, or to determine for itself whether the applicant has made any misrepresentation in this application or has failed to keep and perform any agreement or covenant provided in this application.

7. That the applicant will either cause any cross-connection on its premises to be permanently and completely disconnected to the satisfaction of the water company or will not object to discontinuance of water service to the premises, if, when or as any misrepresentation or failure of performance by the applicant be discovered touching any matter covered by this application; or if the aforesaid cross-connection— be not installed, operated or maintained in such manner as will, in the opinion of the manager or sanitary engineer of the water company, safeguard the interests of the water company or its other customers; or if, in the opinion of the manager of the water company, conditions are such that the aforesaid cross-connection— may be permanently and completely disconnected without unreasonable hardship on the applicant; or if, because of the nature of the aforesaid cross-connection— or the manner of operation, this application be not granted by the water company; or if the water company be in receipt of an order from health authorities or plumbing inspectors to discontinue service to the premises on the ground of dangers to health because of the existence of cross-connections or interconnections on the premises; or if the water company has knowledge that health au-

thorities or plumbing inspectors have ordered a cross-connection or inter-connection existing on the premises to be discontinued or broken and such order has not been complied with.

8. That the applicant, its heirs, successors and assigns, covenant and agree that it will indemnify and save the water company harmless from any and all loss, damage, liability, claim or demand, arising from, based upon or caused by any condition or occurrence traceable to the continued existence or operation, after the date of this application, of any cross-connection on the premises of the applicant, whether or not specifically mentioned in this application.

Signed, sealed and delivered by the applicant the day and year first above written.

ATTEST: .....  
..... (SEAL)

By .....  
SEAL

.....  
(Blueprints or drawings of cross-connection— are to be attached to the communication—Form 1.)

FORM 2  
RECOMMENDATION OF COMPANY  
SANITARY ENGINEER

Dated ....., 194...  
To ....., Manager of  
..... Water Company:

I have examined the attached Application for Continuance of Water Service to Premises on Which a Cross-Connection Exists, and the blueprints or drawings attached thereto. I have also, either in person or by an assistant in whom I have confidence and for whose work I am responsible, made such inspection of the premises and the cross-connections covered by the said



application as I believe to be necessary. I have also made myself familiar with applicable laws, ordinances, rules and regulations.

On the basis of my examinations, studies and inspection, but relying upon the accuracy and truth of the representations made by the applicant as to all matters where careful visual inspection could not reveal all facts and circumstances, I hereby recommend that the ..... Water Company continue water service to the premises covered by the application without requiring the permanent and complete disconnection of the cross-connection—existing thereon and mentioned in the application.

.....  
Sanitary Engineer for  
..... Water Company

### FORM 3

Dated ....., 19...

To ....., Applicant

Acting in reliance upon your representations, agreements and covenants, and also on the Recommendation of the Sanitary Engineer for the Water Com-

pany, the water company will continue water service to the premises covered by your application without requiring that you permanently and completely disconnect the existing cross-connections mentioned in your application.

The granting of your request in your application is subject to the understanding that service will be continued to the premises in question without permanent and complete disconnection of the cross-connection; only so long as the premises are owned or occupied by you or your heirs, or (if you are a corporation) by your successors in corporate existence; only so long as all representations made by you in your application continue to be true, and only so long as you faithfully perform all of your agreements and covenants provided in your application; and distinctly and specifically subject to the terms of paragraph 7 of your application; and will be subject to review and re-examination not less frequently than once a year from this date.

..... WATER COMPANY  
By .....

Manager





## Report on Cross-Connections and Back-Siphonage Connections Under War Conditions

Sanitary Engineering Report No. 8 by the National Research Council, Div. of Medical Sciences acting for the Committee on Medical Research of the Office of Scientific Research and Development

EARLY in 1943 the Committee on Sanitary Engineering, Division of Medical Sciences, National Research Council, concerned itself with the general problem of cross-connections and back-siphonage connections under war conditions. The problems associated with this subject were aggravated beyond those normally encountered in peacetime because of the large and rapid industrial expansion and the tremendous development in land and sea transportation for military purposes.

As a consequence of these unprecedented expansions, a number of public health disabilities were brought to the attention of the committee. Prompt review of the whole situation was desirable in order to eliminate such hazards as were detectable and to prevent future accidents.

With this objective in mind, the committee appointed, in accordance with its usual practices, a Temporary Subcommittee on Cross-Connections as follows:

E. Sherman Chase	Francis M. Dawson	Sol Pincus
Joel I. Connolly	Raymond F. Goudey	Warren J. Scott, <i>Chairman</i>

The subcommittee was requested to review the situation prevailing in 1943, to scrutinize such rules and regulations as had been promulgated by military, semi-military, and civilian agencies; to recommend modifications in policies and in practice on the part of these control groups; and to summarize its conclusions and recommendations for needed action.

The subcommittee has been at work over a period of approximately a year. Many of its recommendations have been the subject of negotiation with the military and other agencies, with resulting adjustments in policies, regulations and practices.

In order to make these findings more widely useful, the Committee on Sanitary Engineering has now agreed, with the approval of the National Research Council and the Surgeons General of the Army, the Navy and the Public Health Service, to make these findings public. The following report presents the outstanding conclusions and recommendations currently adopted by the Committee on Sanitary Engineering.

For reasons of security and conservation of space, the appendixes referred to in the report are not herewith reproduced.

Harold E. Babbitt	V. M. Ehlers	Kenneth F. Maxcy
F. C. Bishopp	Gordon M. Fair	H. A. Whittaker
		Abel Wolman, <i>Chairman</i>

Committee on Sanitary Engineering, National Research Council

## Introduction

This report of an investigation of the dangers that exist under war conditions because of cross-connections and back-siphonage connections with potable water supplies is submitted at the request of the Sanitary Engineering Committee of the National Research Council. A brief study of the subject is presented, together with recommendations for eliminating dangers to users of potable water supplies.

The present report brings up to date an earlier report made under date of Nov. 20, 1943, which was later revised in a supplementary report dated Oct. 21, 1944. The supplementary report cited further history and progress under war conditions since the time of the earlier report and reviewed the original recommendations. *While many of the conclusions and recommendations relate to programs that have similar considerations in wartime and in peacetime, the wartime aspect has predominating consideration in this report.*

## Definitions

For the purpose of this report, the following terms are defined:

*Potable* pertains to water of safe, sanitary quality and approved for human consumption by the health or water authorities having jurisdiction.

*Non-potable* is the term applied to water which would be unsafe for human consumption.

*Backflow* means the flow of non-potable water or other liquids into the distributing pipes of a potable supply of water from any source. The flow may be caused by gravity, vacuum or other pressure differential.

*Unapproved supply* means a water supply which has not been approved for human consumption by the health

or water authorities having jurisdiction. Many unapproved supplies used in industrial and in private fire protection work are unsafe for human consumption. Some well supplies, although of safe sanitary quality, may be unapproved supplies in that they do not come under control of the public health or public water authority having jurisdiction over the public supply.

*Cross-connection* is defined as any physical connection, whether permanent or temporary, by means of which water may flow between a public or private potable supply and a non-potable or unapproved supply.

*Back-siphonage connection* is a water supply connection to a fixture, to a container holding unapproved water or solution, or to a drainage, soil or waste pipe, so installed that unapproved water or material from the fixture, container or drain may enter the water supply line.

*Sewer connection* is used to refer to any connection whereby potable water is directly connected to a sewer or drain.

*Process water connection* is used to refer to any connection whereby potable water is connected to an industrial process water apparatus or tank so that process water may flow into the potable water line.

*Interconnection* is used herein only to refer to connections between two potable water supplies.

## Analysis of Types of Cross-Connections and Back-Siphonage Connections

As an example of the great extent of cross-connection and back-siphonage hazards, the following table shows numbers of violations of sanitary principles for the protection of water supply lines, as taken from the records of

one large port city where a thorough study of conditions was made (1942-1943):

<i>Number of industrial plants and military establishments . . . .</i>	<i>319</i>
Cross-connections with non-potable water supplies . . . . .	331
Process water connections . . . .	2,861
Sewer connections (to water supplies) . . . . .	627
Back-siphonage connections with plumbing systems . . . .	6,777
Back-siphonage connections (miscellaneous) . . . . .	3,365
Pierhead connections (un-equipped with protective devices) . . . . .	1,115
Total . . . . .	15,076

### The Peacetime Problem

*Cross-Connections.* Cross-connections have for many years been the subject of study by water works and health officials. Many of the serious water-borne outbreaks in the last two decades have been due to cross-connections whereby non-potable water has entered potable water systems. These cross-connections, when not the result of carelessness or poor design, are made usually for standby fire protection, for industrial water use, for pump priming or for auxiliary boiler feed. Reports and recommendations have been prepared by the American Water Works Association, the New England Water Works Association, the Conference of State Sanitary Engineers and other interested groups. In a comprehensive review of a seven-year period ending in 1936 in the United States,\* Wolman and Gorman state that of 170 reported water-borne

outbreaks, fourteen were due to cross-connections with a polluted water supply. A preliminary tabulation of disease outbreaks conveyed through water in the United States in 1942, as reported to the U.S. Public Health Service by state and territorial health authorities, indicates that of 50 reported water-borne outbreaks, eight were due to cross-connections with a polluted water supply. The Surgeon General of the U.S. Public Health Service on Jan. 11, 1930, issued a communication to all state health officers, stating that cross-connections with potable water systems supplying interstate carriers and non-potable water systems or supplies must be controlled or eliminated to warrant full certification.

In most instances, except for auxiliary fire protection, the peacetime remedy of separation has been relatively simple through the use of tanks filled from overhead connections or through swing connections. Correction of cross-connection conditions on industrial fire protection systems has sometimes been difficult because of weaknesses in public supplies from a fire protection standpoint. This has unfortunately led to a weighing of pollution and disease hazards against fire loss hazards. A committee of the A.W.W.A. states: "It must not be forgotten that, in the United States, fire now takes a toll as great as, if not greater than, does typhoid. . . . It is, of course, problematical how many lives are lost in fires as the result, direct or indirect, of inadequate water supply—probably not a great many. On the other hand, it is true that uncontrolled fires offer a hazard to life as well as to property. Bearing this fact in mind, health authorities must recognize that protective measures

\* Annual Year Book, A.P.H.A., 20: No. 2.

against fire serve also in some degree to save life." \*

This statement is presented because a distortion of the picture along this line from the standpoint of fire protection is referred to later in a discussion of wartime conditions, since such distortion may bring about serious hazards to the public health. It should be borne in mind that one case of typhoid fever may be the focus of many other cases and deaths, so that direct comparisons with injuries or deaths from fire do not present a clear account of the consequences.

Great progress has been made in eliminating cross-connections in the past two or more decades. Unquestionably many thousands of dangerous cross-connections have been broken through co-operative action and through passage and enforcement of cross-connection regulations. Some of these regulations have been adopted by states. Examples are the California and Connecticut state regulations. Numerous local water and health departments (e.g., Los Angeles) have also adopted rules and regulations. It must be admitted, however, that enforcement often falls far behind the setting up of control procedures. State health agencies usually do not have the personnel to carry out the detailed and continuous follow-up necessary. Local water or health agencies may shirk their responsibilities and fail to carry out the necessary detailed surveys and subsequent reappraisals of conditions. Finally, it must be conceded that even with conscientious attempted supervision, new cross-connections or concealed connections may give trouble.

\* Cross-Connection Control. *Committee Report*. Jour. A.W.W.A., 34: 17 (1942).

Double-check valves of approved type, with specially designed clearance, facings, seats and covers have met with a considerable measure of success in preventing backflow into potable water supply systems. Published records of inspections by the Associated Factory Mutual Fire Insurance Companies and the Connecticut State Department of Health, covering large numbers of check valve installations over a period of years, indicate that a great degree of reliance can be placed on double-check valves. However, Connecticut prohibits new check valve installations, although continuing old ones under approved conditions. New York requires that where check valves are used, the auxiliary unapproved supply be equipped with an automatic chlorinator as an additional factor of protection. In some states, check valves are not allowed at all. The experience does not favor dependence on check valves of less than 6-in. size.

In 1941, a committee of the A.W.W.A. reported that in 28 states cross-connections were under definitely established rules and regulations and that in 20 states they were controlled only under general powers. The committee considered that in 26 states control was "good," in seventeen states control was "fair," and in five states control was "poor." While some improvement may have been effected since 1941, sanitary control of cross-connections was far from perfect prior to the outbreak of war. It is to be noted that most studies of cross-connections such as that of the A.W.W.A. Committee have not included connections with used or circulated water, originally from a potable water supply but later rendered non-potable. This field needs further investigation.

**Back-Siphonage Connections.** Back-siphonage connections between potable water supply lines and plumbing systems may actually admit sewage to water lines under certain hydraulic conditions. In hospitals, equipment may be used with submerged inlets and connections so installed that infections or poisonous materials may be back-siphoned into the potable water supply pipes. Submerged inlets to factory process tanks holding poisonous solutions may result in contamination of the potable water supply should back-siphonage occur. It is readily conceivable that opportunities for sabotage may exist because of backflow of dangerous solutions in industrial plants.

The number of back-siphonage connections is so vast and the possibilities of isolated instances of sickness through them are so great that any estimate of the damage done through them must almost rest in the realm of conjecture. If we call peacetime cross-connection control in the nation only "fair" or "far from perfect," we might readily designate peacetime back-siphonage connection control as "poor."

Dangerous back-siphonage conditions are caused through improperly designed fixtures, through undersized or overloaded water piping, or through improperly installed piping. Considerable progress has been and is being made in the manufacture of fixtures which will not permit back-siphonage. Comparatively little has been done to eliminate old faulty fixtures. Some effort has been made to prevent new bad installations. Plumbers through their organizations have tried to promote safer practices both through the use of tested and approved fixtures and through control of plumbing by licensing and adoption of adequate codes. Certain health departments, notably in

some of our large cities and in some of our states, have done commendable work.

Water utilities, by and large, have not entered forcefully into the field of back-siphonage control. This is perhaps due to the fact that they may consider their job is done when they pipe safe water to the property line or building, and they may contend that it is up to the public health authorities to take steps to protect the safety of the water in the buildings under private ownership. Of course, the public water supply mains may be infected through back-siphonage connections even though most frequently the damage may be limited to the users in the buildings where the faulty back-siphonage connections are located.

It is unfortunate that few states as yet have adopted state plumbing codes, because this would do much to eliminate back-siphonage hazards. While local communities have in many instances adopted excellent codes, much progress remains to be made. Sizes of water piping, methods of installation and piping use are not adequately covered in many local codes.

Time does not permit a complete review of the many dangerous occurrences in this field of back-siphonage connections but reference is made to a bibliography on "Plumbing and Public Health" prepared in mimeographed form by Arthur P. Miller, Sanitary Engineer, United States Public Health Service, New York City, in 1940. This includes 360 references to published papers and discussions.

### Changed Conditions in Wartime

The number of dangerous cross-connection and back-siphonage connection conditions has unquestionably increased due to (1) a large number of



new industrial plants, (2) enlargements of old industrial plants, (3) changed processes in industrial plants, (4) demands for increased fire protection by war agencies, and (5) increased shipping activities. The speed necessary in wartime construction is a factor that may lead to oversight or neglect of necessary health precautions. The evidence is that the war impact may have entered this field especially in (1) permanent cross-connections for auxiliary fire fighting supplies from unapproved sources such as in industrial plants, (2) temporary cross-connections for auxiliary fire fighting supplies from unapproved sources either through "siamese" or other connections in factories, docks or vessels, (3) permanent or temporary cross-connections with auxiliary unapproved water supplies used for industrial work or during construction, (4) permanent or temporary cross-connections with auxiliary unapproved water supplies used for pump priming or boiler feed in industries, (5) back-siphonage connections through submerged inlets in industrial process tanks filled with poisonous solutions, and (6) back-siphonage connections with plumbing systems or special service fixtures in new or enlarged industrial plants, hospitals or other public buildings. The great increase in concentration of workers in factories and in the populations of our cities means that adverse effects from pollution of water will now be far more extensive than in peacetime.

Inspectional facilities by supervisory local and state agencies since the advent of war have been reduced by personnel depletions; military and industrial construction undertaken by the federal government may not have al-

ways been subjected to local or state official scrutiny or local or state regulations; many of the personnel assigned to operating water supply connections and equipment are not adequately instructed and supervised; shortage of materials for pipe, valves, pumps, storage tanks and other structures that might readily eliminate the need for cross-connections has resulted in dangerous short-cuts and practices not normally adopted; such military considerations as protection against sabotage or possible sudden loss of valuable materials and equipment may have actuated adoption of measures that would not have been countenanced by the agency in peacetime. All of these factors when superimposed upon the imperfections of peacetime protective measures have unquestionably produced serious hazards that merit attention and action.

### **The Record of War Agencies and Industries**

Some evidence has accumulated to indicate that, as a result of changed conditions in wartime as just discussed, some of the principles and standards regulating practices in the field of cross-connections and back-siphonage connections with potable water supplies during peacetime are being abrogated in one direction or another during wartime, with possible serious risk to industrial workers, members of the military forces and the general public. This subcommittee at the time of its first report on Nov. 20, 1943, endeavored to explore this field by communicating with a selected group of officials who, because of their geographical locations or special activities, might be most likely to furnish data based on experience. It was not attempted to



assemble any complete summary of water-borne outbreaks which since the advent of war might be attributed to cross-connections or back-siphonage connections. Rather it was attempted within a very short time to secure a few representative examples from sections of the country, preferably spread among establishments under the control of a number of wartime agencies. The subcommittee has not considered it necessary to re-tabulate the data obtained and bring the record up to date, inasmuch as a sufficient cross-section of experience is recorded in the data below, although it should be noted that despite steps taken by the armed services and various administrative agencies since the issuance of the earlier report serious instances of backflow contamination of water piping systems have continued to occur, especially at ship-side outlets and on vessels.

The 1943 returns from the selected individuals or members of the subcommittee cover conditions in Alabama, California, Connecticut, Illinois, Louisiana, Maine, Massachusetts, Missouri, New Hampshire, New York, Ohio, Pennsylvania and Texas. Some of the general situations were covered by letter. The returns from Alabama, Connecticut, Maine, Massachusetts, Missouri, New Hampshire, New York state exclusive of New York City, Pennsylvania and Texas reveal no specific examples of outbreaks of disease as a result of cross-connection or back-siphonage conditions brought about because of the war. However, returns from New York City, Chicago, California, Louisiana and Ohio do show that serious outbreaks of disease have occurred. A tabulation of returns from questionnaires has been prepared.

These returns are discussed under sub-headings below. Twenty instances of examples of dangerous conditions are cited in the returns.

*Reports of Water Pollution by Pumping Into Mains.* Of a total of eleven reported examples, eight instances of pumping polluted water into drinking water mains were at pierhead connections; two were in industrial plants; and one was the action of a construction contractor. Of the eight instances referred to, four were under the jurisdiction of the U.S. Navy, two under the jurisdiction of Navy and Maritime Commission, one under the Maritime Commission, and one was on an Army transport.

*Back-Siphonage Connections With Plumbing Systems.* Seven instances of serious back-siphonage connections with plumbing systems are reported where the evidence indicated that pollution flowed from plumbing systems to contaminate water supply lines. Two of these instances were in connection with industrial plants having war contracts or were close to military establishments; three were in Army buildings; two were in buildings housing Army students.

*Back-Siphonage Connections With Process Water.* One instance of back-siphonage of process water, possibly containing dangerous chemicals, into potable water supply lines is cited in an industrial plant.

*Report of Employee Filling Water Containers.* One instance is reported in a shipyard where an outbreak of disease was caused by the filling of water barrels with polluted water.

*Disease Outbreaks Noted in Returns.* The returns below indicate the occurrence of twenty disease outbreaks, reported to be distributed among es-

tablishments serving various federal agencies, as follows:

- Four—U.S. Navy—New York City, San Francisco, San Diego, Los Angeles—minimum of 1,065 estimated cases of gastro-intestinal disease.
- Two—U.S. Navy and Maritime Commission—San Pedro, Terminal Island—estimated several thousand cases of gastro-intestinal disease.
- Two—Maritime Commission—Stockton, Wilmington—minimum of 200 cases of gastro-intestinal disease.
- Five—U.S. Army—New Orleans, 1; Los Angeles, 4—minimum of 200 cases of gastro-intestinal disease, 2 deaths.
- Four—U.S. Air Corps—Los Angeles, 4—minimum of 600 cases of gastro-intestinal disease.
- Three—War Industry—New York City; Chicago; St. Mary's, Ohio—2,225 cases of gastro-intestinal disease.

Due to censorship, exact figures of the number of persons made sick or exposed to disease outbreak are missing in many instances. The tabulation (not reproduced) indicates that a total of about 100,000 persons were exposed to disease hazards.

*Disease Outbreaks From U.S. Public Health Service Tabulation.* The tabulation of disease outbreaks in 1942 prepared by the U.S.P.H.S. and previously referred to indicates the occurrence of two water-borne disease outbreaks which were apparently in establishments or industries associated with the war program and which were apparently due to cross-connections or back-siphonage connections on properties served, as follows:

- One—Shipyard—Superior, Wis.—13 cases of gastro-intestinal disease.
- One—Shipyard—Camden, N.J.—447 cases of gastro-intestinal disease.

*Unreported Instances of Pollution Through Pierhead Connections.* It is the belief of this subcommittee that many cases of serious pollution of potable water lines have occurred without being reported to any civilian agency. It is difficult for this subcommittee to obtain information from the military agencies in wartime as to cases where improper use of pierhead connections may have caused pollution of water supply lines.

*Back-Siphonage Connections in Military Hospitals.* The dangers of back-siphonage pollution from hospital fixtures undoubtedly may exist in military hospitals, but this subcommittee does not know how extensive an attempt has been made to check the existence of such dangers and eliminate them.

### Pierhead Connections

Pierhead connections presumably installed to supply the vessel with potable water for drinking or for fire fighting do provide a ready method of polluting potable water. At pierheads, the use of auxiliary fire pumps for non-potable water, either situated on vessels or on shore, frequently through temporary hose lines, may result in pollution of potable water in one of the following ways: (1) cross-connections made between potable water lines on a vessel and non-potable water in a fire line or sanitary system of a vessel whereby the vessel potable water supply may be polluted; (2) cross-connections made between potable water line on shore and non-potable water on fire line of vessel whereby non-potable water may be carried to other users of the potable water system including this and other vessels; (3) cross-connections made between potable water line on shore and non-potable water in shore fire

line whereby non-potable water may be carried to potable water system of users of water at pierhead; (4) cross-connections between potable water line on shore and a standby pump on auxiliary supply vessel or elsewhere, such pump being used to increase the speed of water supply to the ship being serviced. The dangers of cross-connections at pierheads are aggravated when there are a number of vessels using common pierhead outlets.

### Steps Taken by Federal Services

Since the date of issuance of the original report, information has reached the subcommittee with regard to certain steps taken by federal services in connection with prevention of backflow contamination. These are discussed below.

*U.S. Coast Guard.* The U.S. Coast Guard has issued a set of instructions to reduce the danger of occurrence of backflow contamination, especially with relation to fire service (amendment of Section 6.355 of "Regulations for the Security of Vessels in Port"). These instructions include directions for maintenance of fire service connections from the potable water supply line (1) when vessels are with power and (2) when vessels are without power. The principal weaknesses of these regulations are that they place complete dependence upon manual operations and upon instructions that are likely to be disregarded in the case of fire service and that they do not cover adequately the use of water for domestic service. It is only fair to state, however, that these regulations have been a definite step forward and have afforded substantial reduction in the hazard of backflow contamination through fire services.

*U.S. Army.* The Army Service Forces have issued a set of instruc-

tions somewhat similar to those of the U.S. Coast Guard, but these later regulations include improvements in that they cover the question of protection of domestic water service and call for the installation of backflow preventive devices when connections are made with ship fire pumps inoperative. In reviewing these regulations, it is recommended that Section 4 be changed to eliminate the words "or after the vessel's pumps become operative," inasmuch as this wording may lead to confusion in interpretation.

The sanitary programs of the Provost Marshal and the Surgeon General of the U.S. Army, the Army Air Forces and other procurement agencies have included the inspection of the water piping systems of military establishments and thousands of war production plants. These programs were well conceived and were productive of much good in reducing backflow hazards although lack of personnel has limited the scope of coverage.

*U.S. Maritime Commission.* While this commission, so far as the subcommittee knows, has issued no directives to all of its personnel regarding control of backflow hazards, excellent co-operation has been given to local programs in some sections of the country, such as along the West Coast.

*U.S. Navy.* The subcommittee is informed that the Navy is now giving consideration to the preparation of a memorandum to its personnel which would call attention to the hazards of contamination from backflow and would present instructions relative to installation of backflow preventive devices where needed.

*U.S. Public Health Service.* The new water supply standards promulgated by the Surgeon General for interstate carriers have emphasized the

need for control of backflow contamination and have tended to direct additional attention to the subject.

### Methods of Prevention of Backflow Into Potable Water Systems

Varying degrees of protection against backflow of non-potable water or other liquids into the distributing pipes of a potable supply of water have been sought in the following ways:

*Method 1.* Physical separation with a safe air gap as specified in "American Standard Air Gaps in Plumbing Systems" \* (approved by American Standards Association, 1942).

*Method 2.* Use of a vacuum breaker installed on the discharge side of the last separating control valve and so placed that there is no back pressure when the normal flow ceases (see specifications approved by A.S.A., 1943†).

*Method 3.* Use of a backflow preventer which operates under pressure and which has a central zone between check valves or equivalent in which zone the pressure would at all times be maintained less than the pressure on the potable side; with a relief opening from the central zone to atmosphere discharging the following minimum quantities without the pressure in the intermediate zone exceeding the pressure on the inlet side for any pressure on the inlet side greater than  $\frac{1}{2}$  psi.

Size of Device in.	Capacity gpm.
2	16
3	25
4	35
6	60
Larger	100

\* A.S.A. (A 40.4—1942).

† A.S.A. (A 40.6—1943).

*Method 4.* Use of double-check valves of 6-in. size or larger, designed and installed to seat readily and completely and equipped for testing, as approved by the health or water authorities having jurisdiction.

*Method 5.* Use of single-check valves on 2-in. lines and larger, accessible for inspection. For ship-side outlets, such valves should be connected with short nipples and installed on a slant of 10 deg. from the horizontal, so as to permit ready inspection and complete drainage.

*Supplementary Protective Steps.* In the application of the above methods it may also be desirable in certain special instances as supplementary protective steps to install differential pressure vacuum breakers in locations where vacuum relief is necessary, or safety valves to guard against excessively high pressures such as above 175 psi. For 2-in. or smaller pipe, vacuum breakers should have full-size opening equivalent to the circular area of a diameter equal to the size of the pipe; for pipe over 2 in. in size, an opening equal to a circular area with 2-in. diameter is acceptable. Safety valves should comply with A.S.A. standards.

### Conclusions and Recommendations

Following are the conclusions and recommendations of this subcommittee. The "methods" referred to are described previously under "Methods of Prevention of Backflow Into Potable Water Systems."

1. It is recognized that the ultimate ideal in the field of cross-connection control is to develop potable water supply distribution to the point where auxiliary water supplies are not necessary, but this ideal cannot prevail at ship-side locations. Moreover, in addition

to cross-connection considerations, the possibilities of back-siphonage with plumbing systems, process water systems and sewer systems exist. This subcommittee recommends that steps be taken to protect backflow connections between potable and non-potable water supplies including those at pier-heads and industrial water-using processes and between potable water supplies and sewers or drains.

2. Personnel assigned to operating water supply connections and equipment should be adequately instructed and should be supervised at all times; such personnel should be furnished a clear statement as to duties and responsibilities with respect to the protection and safety of the water supply.

3. Every connection with a plumbing system which will permit back-siphonage should be eliminated when possible; otherwise it should be provided with an approved type of vacuum breaker.\* Whenever there is possible occurrence of vacuum in a water pipe, means for rapid dissipation should be provided.

4. Every process water connection should be separated from the potable water supply by Method 1, unless due to local conditions or as a temporary measure Methods 2 or 3 are permitted by the local water and health authorities having jurisdiction. Process water connections should receive attention both within and without buildings and include connections to process water tanks and recirculating systems.

5. Every direct cross-connection between potable water lines or apparatus holding potable water and sewers or drains should be broken, and air-gap separation should be used.

6. Where pipes for potable and non-potable water exist, such as in industrial plants or on vessels or docks, pipes should be so painted, posted or otherwise marked as to be distinguishable readily; where possible, all outlets of non-potable water lines should be made unavailable for drinking. All shore connections into which fire boats may pump should have distribution systems separate from systems carrying potable water.

7. In many cases the inadequacy of pipelines conveying water to pierheads from approved sources has tended to promote the use of unapproved auxiliary water supplies at pierheads. It is recommended that federal agencies institute a survey of water service and distribution pipe adequacies at pierheads.

8. During the war emergency, protection of the shore users near pier-head connections should be afforded at or near the property line by Methods 3 or 4 on domestic and fire lines carrying potable water.

9. *In addition to protection at the property line*, backflow preventive devices should be installed at each ship-side outlet, whether for domestic or fire service. Method 3 represents the best type of protection and should be used for protection of each individual ship-side outlet on fresh water fronts where freezing temperatures are not encountered and so far as practicable at all other locations. However, under some conditions, modifications of the use of Method 3 may be desirable so that the following substitute methods are considered permissible for the following conditions:

(a) *Pierheads in location on fresh water fronts where freezing temperatures are encountered.* Method 3 to be installed on all lines leading to in-

\* A.S.A. (A 40.4—1942; A 40.6—1943).



dividual piers (except when there is only one pier and the pipeline entering the property is already protected by Method 3) and Method 5 to be installed on each individual ship-side outlet.

(b) *Pierheads in locations on salt water fronts.* Method 5 installed on each individual ship-side outlet is minimum protection. This affords less protection than Method 3 and is distinctly inferior, but a considerable degree of reliance can be placed on the prompt detection of contamination when due to salt water. Protection of lines leading to individual piers is desirable but is not considered mandatory at such locations.

10. All cross-connections between potable and non-potable water supply lines on vessels should be broken and so maintained, as outlined in the current regulations of the U.S. Coast Guard and the U.S. Army. If in an extreme emergency a cross-connection is made on a vessel between a potable and a non-potable water supply, immediate steps should be taken to notify all persons against use of water without being boiled, and all pipes and tanks contaminated should be disinfected after the emergency cross-connection has been broken. Supervisory medical officers or health authorities should be notified as to the cross-connection.

11. The use of double-check valves as a method of prevention of backflow described in Method 4 is inferior as a substitute for Method 3, even on 6-in. water lines or larger, despite the fact that such valves where given adequate maintenance and supervision have been used with a considerable measure of success on many old installations. The weakness of double-check valve protection *per se* is that the forces responsi-

ble for backflow—pressure differential and vacuum—are not destroyed.

12. In connection with the use of the "methods" referred to in the above recommendations, there may be certain instances where special supplementary protection against vacuum or against excessively high pressures should be afforded to aid in backflow prevention. Because of the many varying conditions encountered, no attempt is made to cite such special locations, but "Supplementary Protective Steps" are discussed under "Methods."

13. All backflow preventive devices as listed herein should be selected on the basis of approved design supplemented by operating experience under varying conditions and should be tested and approved by laboratories of recognized national standing with experience in this field. Devices should be designed with due regard to possible effects of corrosion, incrustation, or other deterioration and should be so constructed as to be inspected and repaired readily. Backflow preventers should be properly installed under competent supervision in such a manner that no backflow of contaminating substances through ports or pipes in the devices is possible under any hydraulic conditions. Approved preventers should be marked as to make, type, size and direction of flow.

14. Attention is directed to the need for careful installation of backflow preventive devices to avoid introduction of contamination by the devices themselves. They should be installed where possible above flood level. Where this is not possible, special precautions should be taken. All devices should be installed so as to be readily accessible for testing and inspection and should be properly equipped for necessary testing. Internal inspection and



repair should be carried out at least annually, and tests should be made on a more frequent basis.

15. Effort should be made by federal agencies to promote adoption of state and local codes controlling water piping and plumbing.

16. Local water, health and building departments should co-operate and establish a co-ordinated program to investigate and correct existing dangers from backflow and to control new installations of water and plumbing systems in buildings. Local inspection staffs can undoubtedly be employed to good advantage in this field.

17. The appropriate federal agencies should establish a unified national program and work with state and local agencies to correct and control danger-

ous backflow conditions. Such a program should include the principles and procedures outlined in this report. Specific regulations and instructions for responsible federal personnel should be adopted, and these should cover instructions to the level of the water foremen and engine-room workers on vessels. Training courses for personnel are needed and should be established.

Respectfully submitted,

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#### DISCUSSION—M. Warren Cowles

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This report, in its present form for publication in technical journals, represents in part a consolidation of previous reports and in part an abstract of the report of Oct. 30, 1944. The explanations given are perhaps too condensed to be easily followed, making it difficult for the average reader to understand clearly, even though he may consider himself familiar with cross-connections and their manifold problems.

The report itself is intended to apply only to wartime conditions which, however, have been only partially contrasted with peacetime conditions. The wartime phase involves no change in the types of cross-connections, nor in terminology. It is a wartime report dealing with the manufacture and shipment of materiel for war on a tremendous scale all over the country, with

special emphasis on problems of global shipping, emphasizing pierheads and shipyards. Speed of loading with maximum safety against fire and related hazards is paramount; therefore, peacetime protection against risk of many kinds must be subordinated to national security. When the report is considered in this light, it becomes constructive. From a peacetime point of view, however, it may introduce many more problems than its recommendations will solve.

On the basis of national security in the broadest sense, protection of the quality of water supply in and around pierheads, shipyards and adjacent areas must, of necessity, be made on a basis not of reasonably complete safety, but rather on the basis of a known or calculated risk, somewhat reduced and safeguarded only as far as wartime condi-

tions permit. The case of a few persons made sick from contaminated water on a pierhead or in a shipyard, or in the vicinity of such facilities, is sharply contrasted with the failure of materiel to arrive on time on the fighting fronts. The recommendations are therefore intended to confine any pollution by cross-connections or back-siphonage connections largely to the premises where these conditions originate, and to prevent, as far as possible, the spreading back, as long as normal pressures are available in it, into the distribution system. Such water facilities had to be constructed with a minimum of critical materials and in the quickest possible time. Those who are familiar with the enormous increase in shipping facilities on the Pacific Coast, and to a lesser degree on the Atlantic Coast, may in part realize the magnitude of the problems presented. It is inevitable that such large-scale developments, completed within an unbelievably short time, will produce situations which may become problems when the war is over.

The report, prepared on the basis of calculated risk and primarily representing an attempt to co-ordinate the activities of the several government agencies involved, has accomplished much. There are certain items in the report, however, which should be briefly outlined as a constructive criticism for the future. On p. 436, under "Conclusions and Recommendations," item 1, the statement, "... the ultimate ideal is to develop potable water supply distribution to the point where auxiliary water supplies are not necessary," is much too broad a statement and needs very careful examination. This may be true in some cases, but economics still has a bearing on the

necessity of maintaining auxiliary water supplies in certain classes of industry. The elimination of an auxiliary water supply does not necessarily eliminate cross-connections, using the word loosely, nor does it eliminate back-siphonage connections, all of which may be hazardous. Again, item 6 says that "All shore systems into which fire boats may pump should have distribution systems separate from systems carrying potable water," meaning independent polluted fire systems, as contrasted with a potable system. Every ocean-going vessel is a potential fire boat as all have fire pumps. Although only eight cases of pollution of potable water lines at pierhead connections are referred to in the report, many of these cases probably occurred by reason of fire hose connections from shore to ship—proof, if any is needed, of the desirability of a separate polluted fire system on pierheads. The two statements quoted are therefore inconsistent, showing the necessity of giving further thought to these problems on a peacetime basis. We, as a group, have been much too casual in our thinking.

Two significant statements are made regarding double-check valves as a method of preventing backflow through cross-connections: (1) check valves smaller than 6 in. are not reliable, meaning that the usefulness of double-check valves is confined only to connections 6 in. or more in diameter, and that double-check valves do not dissipate the forces which create pressure differences and leakage conditions, as is claimed for some other types of protective devices. This latter reference is of considerable importance in connection with other types of backflow preventers referred to in the reports where the maintenance of a reduced

pressure zone between check valves under all conditions is assumed to reduce and minimize possible leakage through the check valves. Relief openings are required. These must be above flood level and can be easily installed only in locations where freezing of water pipes does not occur. This type of backflow preventer, due to its mechanical construction, cannot be approved on fire lines but may be set on process water lines where health authorities permit.

The installation of large numbers of these protective devices on pierheads in Los Angeles and other places on the West Coast should give us considerable performance data providing that sufficient manpower is available from now until the end of the war to inspect these valves, and to keep the necessary records which will enable us to determine whether the advantages of the new valve outweigh the disadvantages.

The references to the activities of the A.W.W.A., as used, do not reflect too creditably on the work of the Cross-Connections Committee which was represented in this particular committee by its former chairman, E. Sherman

Chase, as an individual. Anyone familiar with cross-connection problems knows very well that no committee of any of the associations, or even this one, has been able to cover completely the problem and its many ramifications. Problems of fire insurance requirements of dual supplies on sprinkler systems and other logical developments produce complications in the realm of fire protection but there are just as many difficult problems involved in process water and auxiliary supplies as well as in re-used water.

All water superintendents should read the report carefully and think of it in terms of what its application would mean to them. The understanding of the cross-connection problems by water purveyors in certain sections of the country, as indicated by reports made to this committee, has been astonishing. It is therefore urgent that each water purveyor, state sanitary engineer and public health official analyze his present situation with extreme care and plan for the future. If the report accomplishes nothing more than to stimulate the water superintendents, it will have been abundantly worthwhile.

*Reference should be made to abstracts under "Cross-Connections and Plumbing" on pages 500-502 of this JOURNAL.*



# Britain's New National Water Policy

By Henry Berry

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A contribution to the Journal

THE years 1944 and 1945 are going to go down in history in Britain not only because of their great international and military achievements, but also for the important social legislation which came before Parliament. Even in the midst of total war and world upheaval real progress was being made at home.

Among measures of this kind will be ranked the proposals for dealing with water supply and its allied problem, sewage disposal.

The government's policy on this matter was placed before the House of Commons for its approval on Apr. 18, 1944, in the form of a government White Paper entitled "A National Water Policy." Such a pronouncement was not premature, for the present situation with regard to water supply is by no means satisfactory.

The term "satisfactory" is used with regard to ultimate perfection, and it cannot be too strongly emphasized that, even as at present constituted, the water supply situation in Britain compares very favorably indeed with any supply system in Europe. It can, in fact, be regarded as the best in the Old World. This does not mean, however, that one should sit back and admire, for there is much room for improvement.

A source of weakness lies in the multiplicity of water undertakers. In England and Wales there are over 1,000 of these, operating under statutory powers granted by Parliament; plus

as many again which operate without statutory powers. Twenty-six of the statutory bodies supply 50 per cent of the total population, and 123 supply 75 per cent. The Metropolitan Water Board, for instance, supplies about one-sixth of the total population of England and Wales.

True, there have been amalgamations. The Metropolitan Water Board was born in 1902 as a result of the Metropolis Water Act of that year, but it took many years of prior agitation to bring about the amalgamation of the eight separate undertakings then supplying the metropolis. As the White Paper said, the tempo has been far too slow, and while none would wish for amalgamation, nevertheless it is clearly in the public interest that there shall be a radical change by amalgamation of the water authorities in England and Wales.

The water problems of the country previously have never been tackled in a comprehensive manner. There are bodies like the Thames Conservancy and the Lee Conservancy, charged with the oversight of the rivers Thames and Lee respectively, and right well do they do their work. With regard to other rivers, however, there are heterogeneous bodies charged with dealing with various aspects such as fisheries, pollution, catchment, land drainage, etc. It is proposed in the White Paper that bodies called "River Boards," similar to the Thames Conservancy, be set up for most of the English rivers, charged

with the duty of dealing with all matters relating to those rivers.

The majority of the larger British towns and cities have tackled their own water supply problems more or less satisfactorily, but a very different story could be told of rural areas. That eminent international town planner, Thomas Adams, has said that the evils that arise from dealing with related parts and problems as if they were unrelated and disconnected, must remain in the absence of any planning as a comprehensive whole. This is perfectly true with regard to Britain's water problems. There are many parts to this whole—river, streams, underground water, land drainage, rainfall, etc.—and all these parts must be considered.

Private owners of land sink without let or hindrance wells on their land, and, having sunk them, draw water therefrom. Were it possible to draw water from beneath their own land only, there might be a greater show of right than appears; but such water is drawn from far and near and is used for the private purposes of the person or company sinking the well.

Far different is it with any public water supply undertaking. Not only are they not allowed to sink wells without the consent of Parliament but all and sundry may oppose the proposal, and the Parliamentary path for such a public undertaking is indeed a difficult and costly one. Furthermore, the public water undertaking is hedged round with all sorts of conditions as to purity and limitation of output and the like. Naturally it would do nothing to affect the purity of its own water, but a private individual may leave a well in such a condition that it can readily pollute the underground water supply.

It is therefore good to know that the government has declared that sectional interests shall be subordinate to the national interest and that there shall be control of private wells.

In situations where there is an abundance of water in the winter and a scarcity in the summer, it clearly should be the duty of somebody to conserve that water. Thousands of millions of gallons are hurried to the sea by winter floods, the conservation of which would be the salvation of very large districts in the times of summer drought. Up to the present practically the only conservation that has been done in this direction has been the provision of storage reservoirs by the various water supply authorities—frequently at very heavy cost to themselves. This means that the charges to redeem these costs have been borne by the water consumer.

The central planning of water policy is to be the definite function of the Minister of Health in England and Wales, and of the Secretary of State in Scotland. There may be doubts on the part of some concerning the appropriateness of the Minister of Health for this work in England and Wales, but, if it is tackled by him and his department with skill and energy, few will quibble over the choice.

Already a Rural Water Supply and Sewerage Bill has been passed whereby government grants, totaling £15,000,000 (\$60,000,000) for England and Wales and £6,375,000 (\$25,500,000) for Scotland, will be available for aiding county and other authorities to provide piped water supplies and sewerage in rural areas at reasonable costs to the dwellers in those areas. Furthermore, provision is made whereby the costs will fall on wide districts instead of on more limited ones. Pro-



vision is also made for these costs to be subsidized by appropriate county councils. Such financial provision will go far toward enabling schemes, which otherwise would be out of the question due to high cost to the consumer and heavy increases in local taxes, to be financially possible.

Up to the present, from a water supply point of view, many rural areas have been "terra irredenta," and it is time they were redeemed. Some villages have mains going through them or near them, carrying water to distant places, while the inhabitants of the villages are dependent on their own private wells, which give water that, to put it mildly, is open to suspicion. It is estimated that 30 per cent of the rural population is dependent on wells.

Dwellers in rural areas desire, and have the right, to have modern amenities of life equally with urban dwellers, and high among those amenities are a piped supply of good water and proper sewerage systems.

The author has long contended the necessity for these two things to march hand in hand, and on this matter has the weighty support of Lt. Col. E. F. W. Mackenzie, Director of Water Examination of the Metropolitan Water Board, one of the leading British authorities on the subject.

The building-up of an area—even when accompanied by proper sanitation—tends to foul the sources of well supplies. The possibilities inherent in an increased water supply without adequate sanitation are too dreadful to contemplate. These must, and Parliament has decided that they shall, march hand in hand.

In the Water Bill of 1945, presented to Parliament on Jan. 31, 1945, which deals with a supply for England and Wales, legislative effect is proposed to

be given to the policy as set out in the government White Paper. As already mentioned, the Minister of Health is to be responsible for water supply, and it is proposed to set up a Central Advisory Committee for the purpose of advising the Minister of Health, and any other minister concerned, on general questions relating to water.

The composition of this committee represents many interests, and it is anticipated that adequate representation will be given to those of the water supply industry.

In addition to this central body, Joint Advisory Water Committees will be set up in various regions.

The minister is given wide powers. For instance, should a water undertaking fail to carry out its statutory duty, the minister may transfer its powers either to himself or to a county council. Stringent measures are to be taken to prevent the undue lowering of the underground water table and no well, borehole or other work may be constructed or extended by an individual, except for the purpose of abstracting underground water solely and to the extent necessary for a supply of water for his domestic purposes, without the consent of the Minister of Health.

Valuable powers are also given to prevent pollution of underground sources, and areas may be defined within which it is necessary to exercise control and prohibit or regulate doing things which would have the effect of fouling the underground supply. Water undertakings may be required to give bulk supplies to one another on reasonable terms, and in case of dispute the minister is to be the final arbiter.

The passage of this bill into law will mark a very big step forward in the water supply history of Britain.



# Prospects and Promises of the Water Works Future

By I. M. Glace

Cons. Engr., Harrisburg, Pa.

Presented on Nov. 15, 1944, at the Virginia Section Meeting, Richmond, Va.

CERTAIN trends or tendencies are apparent in the United States which will influence the design and operation of public water works, and developments are in prospect or already here which are casting shadows for wise operators to observe.

It is obviously impossible to discuss the multiple activities of the water works industry in a short paper. The author, therefore, proposes to touch only on certain phases which are within his own experience and which have become a matter of concern to his clients.

## A National Trend

Before the war, and to some extent before the depression, the use of the automobile had become almost universal even among our lowest income groups, resulting in a decided scattering of the population, over wide areas, with an exodus from the densely populated city districts. This trend was definite before the war and, granting a reasonably prosperous future and the materialization of the promised lightweight, higher-mileage, less costly automobile, is certain to become more pronounced as time goes on. Census figures show that in the 1930-1940 decade an actual drop in population occurred in many cities. When analyzed in detail, it will be found, the author believes, that this exodus is largely from the older more congested wards of the towns. These decreases in city popu-

lations have occurred despite an overall country-wide increase in population. Low-cost transportation has certainly been responsible for this dispersion.

Nor must it be thought that this noticeable trend is confined to domestic consumers. Many small, and some large, industries are already located or are locating outside existing water supply districts. An example of this is the Ford practice at Detroit.

What does this development mean to us, as water works operators? For the small town it may mean a sudden and unexpected expansion of its facilities, if a large industry descends on it; at this time a not unusual happening. From the standpoint of the larger city, and small ones too under conditions of more probable losses in population, it can only result sooner or later in a decrease in consumption and in revenues, unless the public utilities are prepared to extend their facilities and to follow these new homes and factories for service in remote suburban areas. Failure to extend means not only loss of revenue, but also, from the health standpoint, a threat to public health, because of the hazards common to the use of water from a great many individual ground water supplies of doubtful quality, which are certain to be indifferently operated and protected against disease-producing organisms.

If the utilities follow the consumers, as I believe they will, then what? First—the matter of rates for service. In a recent summary (1) a large holding company supplying 78 towns in states extending from Alabama to Iowa and to Massachusetts, with populations of communities ranging in size from those of less than 1,000 to a population of 300,000, listed the number of services per mile of main. The range appears to be from about 23 to 40 taps per mile of main in these typical communities. No such number of services can be expected in these probable new developments, nor can present normal domestic rates be used in such scattered areas to secure an adequate return for service, without an adjustment in rates. Some rate differential therefore seems advisable, based possibly on the number of services per mile of main, or some other similar unit. A number of other administrative problems also seem certain to become of moment, including public utility commission rulings. We are advised that, before the war, the number of requests to commissions for suburban extensions of mains had already become so common in one state that the establishment of a uniform but special procedure to cover these cases seemed warranted.

Another phase of this low-ratio-per-mile servicing has to do with quality. The dead-end problem will be multiplied and, if fire protection is also to be considered, the velocities of flow in mains oversized for domestic consumption requirements will be so low that they will emphasize the deterioration in water quality in the mains which always occurs between the plant and the consumer. It is not unusual, in Pennsylvania Dutch communities, to find as many as 300 or more taps per mile of main along certain selected mains in

the hearts of the cities. The consumption of water from such mains, for ordinary domestic use, is sufficient to induce freshening velocities in the mains and to prevent staleness, even though the mains are of a size that is adequate also for fire-fighting purposes. But if we assume a total of only 23 taps per mile—the figure at the lower end of the scale—the velocity in the lines will approach only 2 to 3 fpm. In other words, in a 6-in. main in lightly developed areas, it would take water about 30 hours to travel 1 mi. The metallic pickup in such a period of time can be very severe.

The author began observations on this problem of stagnation in mains several years ago. In certain special locations, with corrective treatment already in use, and on systems which have been fairly well gridded, the presence of red water has still been marked and is the source of bitter complaint, but only in localized portions of the system where the number of taps has been low. It has been found that the wasting of even very small amounts of water from fire plugs, through small service connections, has always relieved the complaints. The idea of dual supply mains in such areas has been advanced, with small diameter lines for domestic service and larger mains for fire fighting. Where the limit in tolerance between the quantities and velocities desired for one purpose is too great or too little for the other purpose, the scheme has considerable merit, at least for those operators who bear the responsibility for serving a potable water. Present lines, serving two purposes, are only a compromise and please nobody.

Summing up these questions and the prospects created by a dispersal of our population over wide areas, many

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administrative problems, as well as quality problems, are in the offing. We have had a measure of surcease during the war period, but they are apt to recur with renewed force.

### Rates

A suggestion was made above regarding the possibility of a differential in rates for lightly developed districts. Further study of such differentials and adjustments seems to be in prospect. Charles H. Capen, of the North Jersey Water District, in the October 1944 issue of the JOURNAL (2) summarizes one of the problems in this way: "Domestic rates should be particularly examined to insure their carrying a full share of hidden costs that are too frequently omitted." A typical instance will illustrate. The tendency of the more well-to-do consumer to build in the higher and more favorably situated areas of his community is common, even though, as in mountainous districts, this often places him above a normal pressure district and requires high service, or even super-high service, pumping. It is obvious that standard domestic rates for such areas do not provide an equitable rate of return and that citizens in less favored topographical areas, where uniform rates are in use, based on quantities consumed, are bearing a portion of the expense of such additional pumping. Rate differentials seem warranted in these cases, as they do for scattered suburban districts. The author knows that the inclination in the average community is to leave well enough alone, but the prospects are that this problem may be forced on us for a solution.

### Air-Conditioning

Consideration of this problem leads us naturally to the problem of air-

conditioning (3), involving not only rates but also other administrative questions. In a paper presented at the November meeting of the Four States Section in Philadelphia, T. H. Kain, of Columbia—a typical Pennsylvania community with a population of about 12,000—summarized data on a problem which has already had some discussion, but seems certain to be emphasized when the end of the war provides a "go" signal (4). Even the small town will be affected. Kain concludes, after conferences with industrial authorities concerned with the manufacture and installation of air-conditioning equipment, that the so-called water "economizers" now in use in this field are not too effective and that relatively large quantities of water may be required for proper service to a development having apparently potentially immense dimensions. Kain quotes startling figures compiled on proposed installations in one large Pennsylvania city, planned for immediate postwar construction. In his own moderate-sized town he has on file now requests for new service lines for such typical places as a drug store, an American Legion home, a motion picture house and a clothing store. The question of actually supplying water to these properties presents no new or unusual problem to the water works profession, except for a seasonal demand in addition to the usual summer load. Although air-conditioning has already been discussed by the profession from many angles, the author has found as yet no considerable discussion on its rate-making problems. In Pennsylvania the air-conditioning period is about 100 days. Any cash return to the utility for the installation of larger facilities, including larger service connections, to meet the increased supply

load, will have to be secured by the sale of water in approximately only three months. Whether a rate differential will be warranted for such seasonal service apparently remains to be determined, but a study of the problem is indicated. Fire service charges lie in the same field of special rates for special service.

### Corrosion

In the field of purification, certain design and control features are of interest to the author. Particular reference may be made to corrosion and what, for lack of a better word, may be called just cleanliness.

The over-all prevention of corrosion is a tremendous problem and not to be covered here. It is being studied from many angles by many industries, largely from the standpoint of reduced maintenance. To the water works industry, that portion of the problem listed as the internal corrosion of pipelines is the major problem, and bears not only on the life and continued carrying capacity of mains and services, but also on the quality of water. Corrosion is so complex a phenomenon that it warrants all the special efforts being made to correct or prevent it.

For operators, the problem seems to have two phases which, although interconnected, still require different approaches. One is the method of treatment and cure for the already serious tuberculation of many thousands of miles of old mains and services now in the ground, and which we must perforce continue to use. The other phase applies to the use of materials for new projects which will be so resistant to corrosion that they will not multiply our future problems.

Suppose, as is known to be a favorite dream of many operators, you had the

cash-in-hand and the responsibility for the design and construction of a completely new water supply system, including intake structures, purification plant, transmission mains, distribution lines and service connections. What materials would you select for the various parts of such a system? Certainly, in the light of present-day knowledge, consideration would be given to seal-coated and lined mains, to asbestos-cement pipes, to filter bottoms of a non-corroding type, and to resistant alloys for domestic service lines; in short, not only permanence, but also corrosion prevention would become one of your main problems, and justly so. The answers to these problems are not yet clear but the prospects are that the intense research and study now being applied to this problem will result in the development of many new and possibly unique features of design, to aid in the progress already made in the last few years.

### Red and Black Water Problems

The author's experience and requests for assistance from operating superintendents both indicate that the control of corrosion and tuberculation in the many miles of existing old lines is a more immediate problem than the development of materials to resist corrosion in the future. The latter problem is left largely to the manufacturer and the engineer, but the operators are forced to listen to the complaints of their customers about the poor water which is being served, while realizing that the complaints are warranted. Only where the supplies have been carrying a limestone water since their construction are the superintendents usually immune to complaints against red water, black water, etc., depending

on the composition of the pipelines. Even where a clear, colorless and sparkling water is delivered to the transmission mains at the source, deterioration has occurred in the distribution system and such complaints result.

The lining of pipes in place is being increasingly used by the profession as an answer to this problem, and certainly offers some relief from the trouble, at least for the larger sizes of pipe. The expense and the mechanical difficulties involved in the lining of the smaller mains, always in use 24 hours of the day, would seem to limit the usefulness of this method to a degree, with no relief at all for service connections, except through new construction. Nor is the answer to be found always or completely in the correction of the water at its source, through the addition of alkaline compounds. I have yet to observe any system which has not been greatly benefited by such application when practiced under reasonable control, with some understanding of what it is hoped to accomplish, and after a lapse of enough time to make the treatment effective. Nevertheless many problems have been increased by such application. Increased amounts of red water have been observed immediately after correction of corrosion has been started. These have been due, the author believes, to a reversal of the tuberculating processes, the slow to rapid removal, by chemical action, of the tuberculated materials lining the mains, and a subsequent phenomenon now commonly known as "sloughing." This result was commented on by the author in a paper published, with considerable misgiving, in 1937, under the title of "Tuberculation in Reverse" (5), and in later articles, but it is believed now that the principle has been accepted

by most operators as a basic part of the corrosion-treatment problem. The war has interfered with the author's observations and experiments on this particular problem, but not his interest. It still is a definite part of that headache for superintendents, known as "keeping good water good." Sloughing following corrective treatment has placed such treatment unjustly in disrepute in certain towns.

Not only has red water become more pronounced in many instances, but also black water has been produced, although the latter seems to have been confined to those supplies carrying undue quantities of manganese in the raw water source. As a matter of fact, black water, in the author's experience, has been confined to some four supplies taking water from Pennsylvania streams carrying acid mine wastes from the anthracite coal fields of the northern part of the state. Where it has occurred it has been a very serious matter, indeed, much more so than that caused by iron sloughing. It is claimed that sloughing, with the production of both red and black water, is now occurring in Harrisburg, where a change in the chemical quality of the supply has recently taken place.

These colored water problems are an important part of the main problem of supplying good water at the tap; but there are still others of major importance to the operator. The work of Griffin and Chamberlin (6), offers real promise in the field of disinfection of mains, in the determination of effective chlorine residuals, in the rôle played by ammonia in water as it naturally occurs or as it is applied, and in the elimination of tastes and odors. The author sees this problem as a matter of break-point chlorination control applied to the distribution sys-



tem, as opposed to break-point in the purification plant itself. The maintenance of chlorine residuals in the mains at figures which, up to recently, would have been considered impossible, has already been accomplished with excellent results. It is possible that such heavy disinfection may result also finally in the disappearance from tap water of those 48-hour gas-formers which have been a source of annoyance, if not concern, to many bacteriologists.

### Filter Practice

Cleanliness has been mentioned as a problem. This means cleanliness of mains as above outlined, but also refers to the condition of filter sand or other media. For years, in fact ever since the installation of the first sand filter, the profession has been struggling with the problem of how to clean filter media thoroughly and effectively, but without any great success until the recent advent and common use of surface washes. Sand-washing machines, mechanical rakes and high-rate wash have all been demonstrated as only partially effective. The author personally feels that this apparatus—surface wash—has provided the most important advance in filter design since the first rapid sand filter was placed in operation, in so far at least as quality of water is concerned. When compared with other wash water methods, the resultant cleanliness of the sand after several washings is astonishing, and when coupled with pre-chlorination and proper coagulation, a product can be produced which is a source of pride to the operator. The author predicts the almost universal use of surface wash in the future, unless and until something still better is developed.

Filter washing methods lead naturally into some other thoughts on filter design. Up to this time, practically all surface washing equipment has been adapted to existing units, to the partial detriment of its effectiveness. If any filters have been designed or built with circular surface wash apparatus controlling the area, size and shape of the units, such construction has escaped the author's attention. He predicts that many future filters will be designed with this end in view.

In the field of design, it appears that greater emphasis will be placed on the use of non-corrosive filter bottoms and that continued attention will be given to proper mixing and conditioning before coagulation. Important advances in this phase of operation have been made in the last few years, with the recognition that proper coagulation is imperative if water of a satisfactory quality is to be produced by the purification plant. As a matter of fact, in view of the importance of coagulation as now practiced, the term "filter plant" probably should not have been applied to our mechanical plants. More probably they would have been called chemical precipitation works, to distinguish them from the earlier slow sand plants, if such a difference had been recognized earlier. This would conform to a similar designation in the sewage works field.

### Summary

Space permitting, the author would have liked to discuss the increased use of pre-stressed concrete, and such use in conjunction with gunite concrete, the greater emphasis being placed by most operators on leakage surveys, not only as an initial operation, but as a customary operating habit; the ap-

parent folly of cleaning mains without at the same time instituting corrective treatment for that quality of the water which produced the tuberculations, removed at considerable expense; the failure of gridding to relieve red water conditions; the noticeable trend toward better operation, by operators with some technical background, and the influence of voluntary or compulsory licensing on such operation; and the regulations or recommendations of the U.S. Public Health Service.

The following predictions have been made:

(1) A major dispersal of population, involving administrative problems, rate changes, effects on quality, and the possible use of dual mains.

(2) A possibility of further differential rates in consumer costs.

(3) An impact from air-conditioning developments.

(4) An attempt to distinguish, in research on corrosion and tuberculation, between the problems involving new mains and those involving the old ones now in service.

(5) Further study on the phenomenon of "sloughing."

(6) An influence on future filter design, by surface wash developments.

With the return of our younger men from the wars, in view of their training in greater self-reliance, in initiative, in the use of new chemicals and processes, and in construction methods, there is certain to be a quickening of the pulse of the water works profession and a surge upwards toward the perfection that has eluded us; and we can promise that we shall have to keep on our toes all the time, to study, to read and to attend professional meetings, if we, now the oldsters, intend to stay ahead or even to keep pace with these young war veterans when they return.

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# Public Ownership of Utilities in Wellsville, N.Y.

By E. J. Rowe

Supt., Water & Light Dept., Wellsville, N.Y.

Presented on Jan. 10, 1945, at the Wellsville Exchange Club and on Jan. 23, 1945, at the Wellsville Rotary Club

THE village of Wellsville acquired its water and electric utilities in 1915. Since that time the properties have been enlarged and improved by the expenditure of what might be considered a large amount of money.

The book value of the water and electric utilities in 1916 was approximately \$110,000. The use of funds obtained from the sale of bonds and the reinvestment of earnings have expanded the property to the present book value of approximately \$710,000, an increase of \$600,000.

Another illustration of the expansion and development of the properties is found in the records which show that during 1917 the total operating revenue of the electric department was less than \$20,000, an average income of 6.4 cents per kwhr. Compare this with the 1943 operating revenue of over \$150,000, an average of less than 2.4 cents per kwhr.

The total revenue from the sale of water was slightly over \$20,000 during 1917. Last year nearly \$45,000 was received from the same source. Combining these revenues we find that the total for 1917 was about \$40,000, while the corresponding figure during 1944 was nearly \$200,000. General municipal lighting purposes consumed about 3,800 kwhr. in 1917. This increased to nearly 130,000 kwhr. in 1944. The amount of electric energy supplied to

the village for general uses during the period of municipal ownership amounts to over 16,000,000 kwhr.

During the earlier period of operation of the utilities, the village inaugurated the practice of transferring to the electric and water funds \$10,000 a year from the general tax budget as part payment for the cost of such services as street lighting, fire protection and other municipal purposes. In 1928 this was reduced to \$5,000 a year and in 1931 was eliminated. The total accumulation of these transfers, from 1916 to 1931, was about \$134,000.

The total amount that has been received from the sale of bonds for the improvement and extension of both utilities is \$512,000. Retirement of the bonds, in accordance with the terms of the various issues, has reduced the outstanding obligation to approximately \$52,000.

The total of bonds retired and interest paid amounts to \$746,300. Deducting from this the actual amount of cash payable to the water and light fund from the tax budget (\$134,000) leaves a balance of \$612,300 as expended from earnings.

Briefly stated, the retirement of a major portion of bonds and payment of interest from earnings by the utilities has reduced the obligation of the village to \$52,000 and as a security for this investment the present book value,

as stated above, is approximately \$710,000.

In 1938 the old library was remodelled into its present condition at a cost of over \$25,000 from the electric department's funds. Since that time \$55,000 has been taken from the earnings of the water and electric utilities and used for the support of other village activities.

The actual balance of the Public Service Commission's Account Number 280 at the end of the present year is nearly \$340,000. In explaining the purpose of this account, it is necessary to emphasize that all accounting in connection with the electric department is under the close supervision and regulation of the State Public Service Commission.

Since 1936 the auditors of the Public Service Commission have scrutinized and examined this account very closely. One of their requirements is that any service rendered to other departments of the village shall be entered in this account at approximately the book cost. The annual financial report to the State Comptroller does not provide, however, for a similar accounting of water services. [A situation which the Association considers regrettable.]

This sum, \$340,000, represents the actual accumulated *balance* for services rendered by the electric department to the balance of the village for which no payments, either in cash or in kind, were made.

A substantial portion of this balance can be attributed to the deficit of the water department, due largely to the heavy burden of bond and interest payments. The loss incurred by this utility has varied from approximately \$700 to a high of \$24,000 a year. The matter of increasing the rates for water service to meet this deficit has been under dis-

cussion at various times. The attitude assumed by the Board of Commissioners in the past has been that nothing should be allowed to jeopardize the health conditions in the community. Years ago during the period of greater deficit in the department it was considered that raising the water rates to meet this deficit would increase the use of wells, springs and questionable water supplies. The time is near when the bond payments will be reduced to a level that will permit the revenue of the water department to meet its obligations.

Such items as electric energy used by the sewerage system, municipal buildings, traffic lights, parks, street lights, etc., are entered in the account at practically book cost.

Deductions are made from this account for any payments made from the village general funds as well as an allowance for rental of office space, etc.

During any action by the Public Service Commission this account has a conspicuous role in determining an allowable return on a rate base.

### **Growth of the Water and Electric Utilities**

The years of 1921, 1922 and 1923 were notable for a complete change in the characteristics of both the water and the electric properties. A new steam turbine, boilers and rapid sand filter plant were placed in operation during this period.

The filter plant, with a capacity of 1 mgd., was constructed at a cost of approximately \$45,000. At the time it was placed in service the average amount of water consumed throughout the village was approximately 450,000 gpd. Today consumption is more than 90 per cent of the maximum capacity of filters and pumping equipment.

This increased demand has reduced reserve capacity to a dangerous level. Any excessive demand resulting from use or accident, such as a broken hydrant or fire, endangers any reserve in storage.

It is interesting to note that during 1944 the ten largest consumers of water were billed for almost as much water as the average consumption of the entire village at the time the filter plant was constructed. During the month of December 1944 ten consumers used 423,000 gpd.

### Steam for Public Heating

Steam is extracted from the turbine generating unit to supply heat to a number of buildings, such as the schools and library and hospital properties. These properties used 14,200,000 lb. of steam last year. The revenue from this consumption amounted to approximately \$5,100.

It is difficult to estimate the actual cost of supplying this service without entering into calculations that would be of little interest to the majority. It can be said, however, that, basing the estimate on the present coal cost, the actual cost of fuel to generate this amount of steam would be over \$4,000. Taxpayers derive a tremendous saving in general by this method of heating the properties. The cost of labor and maintenance and the expenditure of capital funds for separate heating plants, as well as attendant smoke and dust nuisance, have been eliminated.

The steam line from the power plant to the high school was paid for by the Board of Education. Cost of the extension of this line along the river bank to serve the hospital and library was covered by funds received from a \$20,000 bond issue to be retired in ten years. The cost of retiring the prin-

cipal and payment of interest is added to charges for steam.

### Taxes

The opponents to municipal ownership of utilities always stress the amount of taxes paid by utilities when operated by private interests. After extended hearings by the Public Service Commission, attended by their so-called "tax experts," it was declared that in so far as the electric department or its properties were concerned, the amount of equivalent taxes that should be assessed against that department should be approximately \$3,700 for the year 1941. By applying the same method of calculation as is used by the Public Service Commission's experts, it is found that the estimated taxes the village would have received under private ownership of its utilities would not have exceeded \$100,000 since 1915 for both utilities. As a comparison, the tax experts of the Public Service Commission computed a tax equivalent of \$3,673 for the same period. Wells-ville has used the \$4,363 rate because it is considered more liberal and tends to remove the subject from the realm of controversy. The most equitable comparison demands a balancing of the value of services received against any losses incurred.

### Future Prospects

Examination of statistics and records indicates that the rate of expansion in the use of utility facilities up to the outbreak of World War II was very rapid.

Naturally, those concerned with the operation of all utilities consider that some recession will be experienced immediately upon conclusion of hostilities. This recession will be, to a certain extent, counter-balanced by expanding



use for general household purposes. The demand for electricity for cooking purposes greatly increased during the thirties, indicating a more widespread use as soon as cooking appliances are again available to the general public. The rates at which electric energy is sold at the present time for this purpose render this class of service attractive to the average householder. There is a steady demand for a higher level of illumination in the individual home. The use of small motor-driven household appliances is becoming more general.

Even when allowance is made for the sharp decline from the rate of increased use of electric energy experienced during the 1930-1940 period, it seems reasonable to expect the rate of increase will be maintained at a fairly high level during the ten years following the cessation of hostilities.

### Obsolescence

The time is near when the expenditure of fairly large sums will be necessary for further expansion, improvement and replacement of obsolete equipment to maintain satisfactory and economical service to the village. It is unfortunate that all machinery and equipment reach a point at which they are either inadequate or obsolete. The rapid advance made in the design of mechanical equipment is such that obsolescence often occurs prior to depletion of useful life. To illustrate such obsolescence, there are here quoted some figures from the record of the electric generating plant.

During 1919 the delivered cost of coal was \$5.44, with an average cost of 2.08 cents per kwhr. The 1926 coal cost was \$4.40 or 0.82 cent per kwhr. Adjusting these costs to a comparable basis we find the 1926 fuel costs to be

approximately 1.0 cent per kwhr., approximately one-half the former cost. This illustration spans one period of improvement in equipment and utilization of fuel. In 1944 the same adjusted cost has been reduced to approximately 0.55 cent per kwhr. These progressive decreases in fuel costs are the direct result of the installation of improved types of equipment.

Some of the equipment needed to replace or supplement that now in use may be summarized as follows:

A new switchboard should be installed. A second-hand switchboard was purchased and placed in service in 1921. This board was capable of handling a maximum of about 1,200 kw. At the time of installation the peak loads on the plant were around 300 kw. Today this board is required to handle a load of over 1,700 kw. on many occasions. At the time of installation it was considered a fairly modern piece of equipment, yet today it should be regarded not only as obsolete but also dangerous.

A 2,500-kw. steam turbine unit should be installed.

A larger steam generating unit to supply steam for the 2,500-kw. unit and the necessary extracted steam for heating purposes is needed.

Two marine-type hand-fired boilers were purchased from war surplus stocks in 1920. These boilers have had approximately 20 years of hard service and should be replaced. It is thought advisable to remove them and install one larger steam generating unit capable of producing at least 40,000 lb. of steam per hour. An installation of this character would provide two efficient steam generating units—one of which would always be held in reserve.

The present generating capacity of the electric department consists of one

efficient 1,500-kw. Moore steam turbine unit (1932) and one 500-kw. Kerr steam turbine unit installed in 1923. The latter unit was installed in connection with the two marine-type boilers and is designed to operate at low pressure. It is possible to convert this unit to higher pressure, thereby obtaining greater efficiency by utilizing the generator and condenser equipment and placing a modern high-pressure steam turbine on the bed plate.

This conversion will still be deficient in reserve capacity for emergencies, as well as in total generating capacity. Therefore, it may be more economical to install a new high-pressure steam turbine unit of approximately 2,500-kw. capacity in addition to the conversion of the Kerr unit. This conversion and installation of the larger unit can be done with a minimum change in the structures housing the generating units.

The filter plant is operated at practically its maximum capacity 24 hours a day and seven days a week. The construction of a mechanical flocculator would increase the filter plant capacity approximately 25 per cent. The flocculator, together with two new pumps of greater capacity, should provide a reserve capacity of approximately 200,000 gpd. of water.

Another handicap under which the water department is operating is the lack of adequate auxiliary storage of water for domestic use and fire protection. There is one 3-mil.gal. storage reservoir for this purpose. Due to the heavy demands for water it is practically impossible to inspect, clean or repair this treated water storage reservoir. Increasing the filter plant and pumping capacity and installing an auxiliary storage reservoir having a capacity of approximately 600,000 gal.

would permit systematic inspection and cleaning of the larger reservoir.

Since 1927 it has been necessary to purchase a large amount of electrical energy from a transmission line to make up the balance the present equipment has been unable to supply. During this period approximately \$300,000 has been paid for this purchased energy, at an average rate of approximately 1.11 cents per kwhr.

Due to the excessive demands of war industries and the inability to obtain scheduled delivery of repair parts, it was necessary to purchase, from sources outside of the village, nearly 300,000 kwhr. at an average cost of 1.38 cents per kwhr. during the year of 1943.

Let us assume that it will be necessary to spend \$250,000 to install adequate equipment to meet the entire demands of electrical energy and water; that the estimated life of this equipment be placed at ten years; and further, that it is necessary to pay 3 per cent interest on borrowed money to complete the installation. The carrying charges on this \$250,000 and the average fuel and maintenance costs will be materially less than the average cost of purchased energy.

### Conclusion

No criterion of the value of municipal ownership has been or can be established. Its value can be stated in terms of services rendered, the cost of this service and the loss sustained (taxes) and a comparison of the costs of service under public and under private ownership. Any statement relative to this value must be an estimation of its effect upon the community at large. Any municipal undertaking should be judged by its value to the community as a unit.

## Laws and Rules Relating to Water Supply in New Jersey

On Feb. 21, 1945, the New Jersey State Legislature passed a law (Chapter 22, 1945) creating a State Department of Conservation, consolidating eleven existing departments and commissions, including the State Water Policy Commission. After July 1, 1945, the State Water Policy Commission will be known as the Division of Water Policy and Supply in the State Department of Conservation. The membership of the commission will be increased from five to nine and the terms of office reduced from seven to five years for new members as appointed.

A compendium of the laws relating to the activities of the State Water Policy Commission is reproduced herewith because of its complete coverage of various aspects of water supply allocation and control within a state.

These "Laws and Rules" were made available through the co-operation of H. T. Critchlow, Chief Engineer of the State Water Policy Commission.

### Authority

The State Water Policy Commission of New Jersey, by virtue of Title 58, Chapter 1, of the Revised Statutes, creating the commission and defining its duties, has jurisdiction over all sources of potable public water supplies, including surface, subsurface and percolating waters, to the end that the same may be economically and prudently developed for public use.

In particular, the commission is charged with the duty of considering applications for the diversion of undeveloped water resources for potable and public use and the approval of works for such diversion and use.

Contracts between municipalities for water supplies must be submitted to and approved by the commission, as provided by Section 40:62-84 of the Revised Statutes.

The right of eminent domain, granted to holders of permits for diversion of potable waters of the state by the State Water Policy Commission or its pre-

decessors, under provision of Title 58, Chapter 6, of the Revised Statutes, may be exercised only with the approval of the commission, on petition and after hearing.

### Rules Regarding Applications for Water Supply

The following rules have been adopted by the State Water Policy Commission for the simplification of procedure and the avoidance of delays. They are subject to change without notice, and are printed here for the information of those having business to transact with the commission. They must not be interpreted as limiting in any way the freedom of the commission. The commission expressly reserves the right to depart from them in any instance where it judges that the public interest will be best served by such action.

1. The application shall be made in writing on forms to be furnished by the commission upon request. Said forms provide for certain information regard-

ing the location of the source of supply, description of lands and/or rights for which approval of right to exercise the power of eminent domain is desired, the approximate location of the proposed reservoir or other works, with their estimated capacity, copies of any official reports relating to the same and showing the need for an added supply, and the reason for the choice made.

2. The application shall be accompanied by a map prepared upon the proper atlas sheet of the Department of Conservation and Development, scale 1 in. = 1 mi., or 1 in. = 2,000 ft., or other topographic map, showing (a) the location of the source of supply, and in the case of a surface source, the drainage area and its size in square miles above the point of intake; (b) the approximate location and estimated capacities of the proposed storage works; (c) the approximate location and sizes of the transmission mains; (d) the location of pumping station and treatment works, if any; (e) the boundaries of the territory to be supplied; (f) the location and names of other existing public water supplies taking water within a radius of 5 mi. of the proposed intake. This information shall be shown in red ink, designating existing works by solid lines and proposed works by dashed lines.

3. Other drawings and data shall be submitted as required by application forms. Drawings must not exceed 30 in. in width, but may be of any length. The title shall be placed in the lower right-hand corner of the drawings and shall specify (a) the name and address of the applicant; (b) the name and address of the designing engineer and consulting engineer; (c) scale of drawings; (d) date.

4. Any other information which may be of assistance in understanding the

need for an added supply, and the reasons for the choice made, should be submitted.

5. All applications for approval of plans and specifications for projects pertaining to water supply shall be accompanied by a certificate of a professional engineer, duly licensed as such under the laws of the state of New Jersey or under the laws of another state having reciprocal provisions relating to the practice of professional engineering in New Jersey, certifying that such plans and/or specifications were prepared by or under the supervision of such certifying engineer.

6. Contracts for water supply between municipalities should be submitted for approval by the commission before final execution. They must be accompanied by a map showing the territory to be supplied and the proposed mains, also the connections with the system that will furnish the water. Certified copies of resolutions passed by the governing body of each municipality authorizing the agreement must also be submitted.

7. Upon receipt of an application in proper form the commission will set a date for public hearing, and issue a notice thereof which it will cause to be published in newspapers circulating in the territory affected by the application. The commission will also notify officials of public water supply systems in the vicinity. An inspection of the site is usually made by an engineer of the commission prior to the hearing. (Note: The regular meetings of the commission are held in the second Wednesday of each month.)

8. The expense of hearings and determination by the commission will be certified to the applicant, who shall pay the bill within 30 days thereafter, as provided by law.

## Establishment of the State Water Policy Commission

### *Revised Statutes*

#### **Title 58. WATERS AND WATER SUPPLY**

#### **Chapter 1. State Water Policy Commission**

*58:1-1. Membership; terms; vacancies.* The State Water Policy Commission, hereinafter in this chapter designated as the "commission," created and established by the act entitled, "An act to conserve, protect, control and regulate the use, development and diversion of surface, subsurface and percolating waters of the state; to control and regulate the construction and maintenance of dams; to create a water policy commission and define its powers and duties and to transfer to such commission the jurisdiction, powers, rights and duties of the Department of Conservation and Development over water supplies, dams and flood control," approved May 6, 1929 (P.L. 1929, Chap. 267, p. 631), as amended and supplemented, is continued. The commission shall consist of five members. Each commissioner shall continue in office after the expiration of his term until his successor has been appointed and has qualified. As the term of each commissioner expires his successor shall be appointed by the Governor by and with the advice and consent of the Senate for the term of seven years. Any vacancy in the commission through death, resignation or other cause shall be filled for the unexpired term in the manner provided for an original appointment except that the term of any commissioner appointed to fill a vacancy existing on the effective date of this act shall be for six years from the date of his confirmation.

*58:1-2. Organization; secretary; quorum.* The commission shall organize annually by selecting a chairman, and appointing a secretary, who shall be an employee of the commission and may, at its pleasure, be discharged.

A majority of all the commissioners shall constitute a quorum for the transaction of business, the exercise of any powers or the performance of any duties.

*58:1-3. Body corporate; regulations; meetings.* The commission is hereby created a body corporate for the purposes authorized herein and shall have an official seal. It may make rules and regulations for its own government and for proceedings hereunder.

The commission may meet at any time or place within the state but shall hold not less than one stated meeting each month. All meetings and the minutes thereof shall be open to the public.

*58:1-4. Attorney general as counsel.* The attorney general shall be the attorney at law for and legal adviser of the commission and shall upon its request, either personally or through a deputy or assistant, furnish it advice and aid.

*58:1-5. Offices; assistants.* The commission may maintain one or more offices for the transaction of its business and employ such engineering, clerical and other assistants as shall be necessary to carry the provisions of this chapter into effect. The commission may fix the compensation of all employees, subject to the provisions of Title 11, Civil Service, except where otherwise provided by statute.



58:1-6. *Accounts; annual report.* The commission shall keep accurate accounts of all receipts and disbursements and shall make an annual report to the legislature before February 1 in each year.

58:1-7. *Commissioners paid expenses only.* The members of the commission shall serve without compensation but shall be paid their actual expenses incurred in and incident to the performance of their duties.

58:1-8. *Hearings by one or more members.* The commission may conduct hearings by one or more of its members in place and stead of the full commission, unless a party in interest appearing before the commission objects thereto. When a hearing shall be so held by less than a majority of the members of the commission all testimony shall be taken stenographically and a transcribed copy thereof furnished each member of the commission. Thereafter the action of the commission upon the matter upon which the hearing was so held shall be as effective as though the hearing was held before the commission.

58:1-9. *Jurisdiction, rights, powers and duties of commission.* The commission shall succeed to and exercise all the jurisdiction, rights and powers and perform all the duties formerly exercised and performed by or conferred and charged upon the Department of Conservation and Development in so far as the same were formerly vested in the State Water Supply Commission and were transferred to said department by an act entitled, "An act to establish a Department of Conservation and Development and to consolidate therein the State Water Supply Commission, the Board of Forest Park Reservation Commissioners, the State Geological Survey, the Washing-

ton Crossing Commission, the State Museum Commission and the Fort Nonsense Park Commission," approved April 8, 1915.

The commission shall exercise all the jurisdiction, rights and powers and perform all the duties relating to the water supplies of the state formerly vested in the Department of Conservation and Development by the act above referred to and in addition thereto all the jurisdiction, rights, powers and duties relating to water supply matters, control and supervision of the construction and maintenance of dams, flood control, drainage, irrigation and water power which were formerly vested in the State Water Supply Commission and its successor, the Department of Conservation and Development, by said act above referred to and by any amendments or supplements and any laws enacted subsequent thereto.

58:1-10. *General supervision over water supply sources.* The commission shall have general supervision over all sources of potable and public water supplies, including surface, sub-surface and percolating waters, to the end that the same may be economically and prudently developed for public use.

58:1-11. *Investigations of water resources.* The commission shall continue and extend investigations of the water resources of the state, including the systematic gaging of rainfall and stream flow throughout the state, so as to complete a comprehensive study for the entire state, for the conservation, development, regulation and use of the waters in each of the principal watersheds of the state with reference to the accomplishment of the following public uses and purposes:

a. The supply of pure and wholesome water from watersheds to mu-

municipalities and the inhabitants thereof and the disposal of sewage and wastes which may affect the supply.

- b. The prevention of floods.
- c. Drainage and irrigation.
- d. The conservation, development and utilization of water power.
- e. The protection of public navigation.

*58:1-12. Report to legislature of results of investigations; plans.* The commission shall report to the legislature from time to time the results of such investigations, with plans, to the end that a complete plan be finally presented for the economical and comprehensive development, for all the purposes enumerated in Section 58:1-11 of this title, of all the water resources in each of the principal watersheds of the state.

The commission shall investigate and report to the legislature as to the consents and privileges granted prior to May 6, 1929, affecting the use of the waters aforesaid, and as to the terms of such consents and privileges and whether the conditions thereof have been complied with, or whether they are revocable, and as to the extent of existing diversion rights and the use being made of the waters affected thereby.

*58:1-13. Plans for watersheds; consents.* Every such plan for any watershed shall set forth the developments already made and authorized to be made in such watershed for one or more of the purposes enumerated in Section 58:1-11 of this title, and the extent to which any such existing or authorized development may be improved, enlarged or extended so as to increase its efficiency for any of such purposes, to the end that all developments in such watershed for all such purposes may be co-ordinated and uni-

fied and the rights of the state asserted and utilized so as to combine the most economical construction, maintenance and operation, and the most efficient service, with the production, maintenance and operation, and which may be practicable.

*58:1-14. Use of previous reports and surveys in investigations.* In such investigations the commission shall, so far as possible, make use of all records, studies, reports and surveys which have previously been made by, or on behalf of, the state or any municipal corporation or civil division, or district agency thereof. Every public officer, department, commission or board having custody or possession of such records, studies, reports or surveys, shall freely make the same available for use by the commission.

*58:1-15. Annual reports to commission relative to water diverted for water supply purposes.* The commission may require annually, reports from all district water supply commissions, municipal corporations and other civil divisions of the state, corporations or persons diverting water, either from surface, subsurface, well or percolating sources, or from a combination of any such sources, for water supply purposes, as to the amount diverted, the proportional amount from each source, the communities and population supplied, the rates charged, and such other matters as shall be requisite to, or useful in, a proper supervision of the water supplies of the state and their development and public use and to determine the charge for the "excess diversion" thereof.

*58:1-16. Report to commission of amount of water used; examination of meters, records and works.* The officers in control of municipal and other water works shall keep accurate rec-

ords by meters, or other approved methods, of the amount of water used and shall report the same quarterly to the commission. The commission may make such investigation of the meters and records as may be necessary to determine all matters pertinent to its duties, and may examine the plants and works of all public or quasi-public water supplies to ascertain the sources of supply and determine the taking and diversion effected, and the charge, if any, authorized by law to be made for "excess diversion."

58:1-17. *Condemnation for new or additional sources of water supply; approval of project by commission.* No district water supply commission, municipal corporation or other civil division of the state, or any board, commission or other body of or for any such municipal corporation or other civil division, and no person or corporation supplying or proposing to supply the inhabitants of any municipal corporation or other civil division of the state with water, shall have power to condemn lands, water or water rights for any new or additional source of water supply, whether such source be surface, subsurface, well or percolating water, or to divert water from such new or additional source (other than for new or additional sources of water supply, the maps or plans for which, in conformity with permits for the taking thereof, were heretofore approved by the State Water Policy Commission or the board or body theretofore authorized by law, to grant such approval), until such district commission, municipal corporation, civil division, person or corporation has first submitted a petition to the commission, as hereinafter provided, and until the commission shall have approved the same as submitted or with such modifications

and subject to such conditions as it may determine should be incorporated in such approval after a hearing as hereinafter provided.

58:1-18. *Applications for approval of maps and plans; contents; security for expenses.* Any district water supply commission, municipal corporation or other civil division of the state, or any person or corporation, may make application by petition in writing to the commission for the approval of its maps, plans and profiles of such new or additional water supply or for such new or additional source or sources of water supply.

The application shall show the sources of the proposed supply and shall be accompanied by an exhibit of maps of the lands to be acquired and showing the sites and areas of the proposed reservoirs, a plan of the other works proposed to be constructed, the profiles of the aqueduct lines and the flow lines of the water when impounded, maps, plans and surveys and abstract of official reports relating to the same, showing the need for a particular source or sources of supply and the reasons therefor, the plan proposed for protecting the new supply and watershed from contamination or the proposed plan for filtering such new supply. The application shall also be accompanied by such proof as to the character and purity of the water supply proposed to be acquired as the commission shall require.

If the application is made by a person or water works corporation, it shall be accompanied by an undertaking in such amount and with such sureties as the commission shall determine, that such person or corporation will pay the expenses of the hearing and determination as hereinafter provided.

58:1-19. *Notice of public hearing; filing of objections to project.* The commission shall thereupon cause public notice to be given that on a day therein named it will hold a public hearing at such place as it may specify in the notice, for the purpose of hearing all persons and municipal corporations or other civil divisions of the state that may be affected thereby. The notice shall be published in such newspaper and for such length of time, not exceeding four weeks, as the commission shall determine.

At any time prior to the day specified in the notice any person or municipal corporation or the proper authorities of any civil division of the state may file in the office of the commission objections to the project proposed by the application. Every objection so filed shall particularly specify its ground.

58:1-20. *Hearing; determination as to plans.* The commission shall, upon the day specified in the notice, or upon such subsequent day or days to which it may adjourn the hearing, proceed to examine the maps and profiles and to hear the proofs and arguments submitted in support of and in opposition to the proposed project. The commission shall determine whether the plans proposed are justified by public necessity, whether they provide for the proper and safe construction of all works connected therewith, whether they provide for the proper protection of the supply and the watershed from contamination or provide for the proper filtration of such additional supply, whether the reduction of the dry-season flow of any stream will be caused to an amount likely to produce insanitary conditions or otherwise unduly injure public or private interests, and whether the plans are just and equi-

table to the other municipalities and civil divisions of the state affected thereby and to the inhabitants thereof, particular consideration being given to their present and future necessities for sources of water supply.

58:1-21. *Action by commission on application after hearing.* The commission shall, within 60 days after the final hearing and with all convenient speed, either approve the application, maps and plans as presented or with such modifications and subject to such conditions as it may determine should be made therein to protect the water supply and the interests of the applicant or of the inhabitants of the territory supplied by it with water, or the water supply and interests of any municipal corporation or other civil division of the state, or the inhabitants thereof, or the water supply and interests of any other person or corporation engaged in supplying water to any municipal corporation or other civil division of the state, or the inhabitants thereof, or to bring into co-operation all municipal corporations or other civil divisions of the state which may be affected thereby, or to make safe all dams or reservoirs to be constructed by said plans; or it may reject the application entirely or permit another to be filed in lieu thereof, but it shall, however, make a reasonable effort to meet the needs of the applicant, with due regard to the actual or prospective needs and interests of all other municipal corporations and civil divisions of the state affected thereby, and the inhabitants thereof.

58:1-22. *Decision in writing; filing; certiorari.* Whenever the commission shall make a decision on any application submitted to it, it shall state the same in writing and cause the same to be filed, together with all plans, maps, surveys and other papers or

records relating thereto, in the office of the commission. The decision of the commission and its action on any application may be reviewed by certiorari.

58:1-23. *Applicant to pay expenses.* The expense of any such hearing and determination by the commission shall be certified by the commission to the applicant who shall pay the same within 30 days thereafter.

58:1-24. *Approval of work before operation of new system.* No new water supply system built in accordance with plans approved by the commission shall be operated until the work has been approved by the commission, except that a temporary use of part of the constructed works may, upon request, be authorized by the commission.

58:1-25. *Interconnecting of water supply systems; rates and terms.* The commission may, upon petition or upon its own initiative, after hearing, upon notice, require by order in writing the interconnecting of public water supply systems, whether in public or private ownership, whenever it determines that the public interest requires that such connection be made, and require the furnishing of water by means of any such system to another, upon fair compensation, reasonable rates and just and equitable terms to be prescribed by the commission, which rates shall be subject to review and adjustment by the board of public utility commissioners.

58:1-26. *Construction and maintenance of structures within streams regulated; penalty for violations.* No structure within the natural and ordinary high water mark of any stream shall be made by any public authority or private person or corporation without notice to the commission, and in

no case without complying with such conditions as the commission may prescribe for preserving the channel and providing for the flow of water therein to safeguard the public against danger from the waters impounded or affected by such structure, and this prohibition shall apply to any renewal of existing structures. No such approval by the commission shall impair or affect any property rights, otherwise existing, which might be invaded by the construction or maintenance of any such structure.

The commission may, whenever in its judgment public safety so requires, and after a hearing either on its own motion or upon complaint, make and serve an order directing any person, corporation, officer or board constructing, maintaining or using any such structure in any of the waters of this state to remove or repair it within such reasonable time and in such manner as shall be specified in the order, and every such person, corporation, officer or board shall obey, observe and comply with the order and with the conditions prescribed by the commission for preserving the channels of streams and for safeguarding the public against danger from waters impounded by structures hereinbefore referred to.

Every person, corporation, officer or board failing, omitting or neglecting so to do, or who constructs or reconstructs any such structure in any of the waters aforesaid without submitting to the commission plans therefor and obtaining its approval thereof, or who fails to remove, construct or reconstruct the same in accordance with the plans so approved shall forfeit to this state not to exceed \$500 for each and every offense. Every violation of any such order, direction or requirement shall be a separate and distinct offense.



and, in case of a continuing violation, every day's continuance thereof shall be and be deemed to be a separate and distinct offense.

58:1-27. *Recovery of penalties; disposition of moneys recovered.* Any action to recover a penalty under Section 58:1-26 of this title may be brought in any court of competent jurisdiction on order of the commission and in the name of the state. In any such action all penalties incurred up to the time of commencing the same may be sued for and recovered therein and the commencement of an action to recover such penalty shall not be, or be held to be, a waiver of the right to recover any other penalty. All moneys recovered in any such action, together with the costs recovered therein, shall be paid into the state treasury by the commission to the credit of the general fund.

58:1-28. *Subpoena and examination of witnesses; production of books and papers.* The commission may subpoena and require the attendance of witnesses and the production by them of books and papers pertinent to the investigations and inquiries which it is authorized to make under this chapter, and may examine them and such public records as it shall require in relation thereto. For the purposes of such examinations the commission shall possess all the powers conferred by statute upon a committee of the legislature.

58:1-29. *Compulsion to testify; self-incrimination; immunity.* No person shall be excused from testifying or from producing any books or papers in any investigation or inquiry by or upon any hearing before the commission or any commissioner thereof, when ordered to do so by the commission, upon the ground that the testimony or evidence, books or documents required

of him may tend to incriminate him or subject him to a penalty or forfeiture, but no person shall be prosecuted or punished or subjected to any penalty or forfeiture for or on account of any act, transaction, matter or thing concerning which he shall under oath have testified or produced documentary evidence; provided that no person so testifying shall be exempt from prosecution or punishment for perjury committed by him in his testimony. Nothing herein contained is intended to give, or shall be construed as in any manner giving, unto any corporation immunity of any kind.

58:1-30. *Commissioners may administer oaths.* Each commissioner may administer oaths in any investigation or proceeding which the commission is required or authorized to institute or conduct.

58:1-31. *Entry upon lands or waters.* The commission or its agents, engineers, surveyors and other employees may enter upon any land or water for the purpose of making any investigation, examination or survey contemplated by this chapter.

58:1-32. *Disposition of moneys collected for "excess diversion" of water.* The commission shall turn over to the state treasurer all moneys collected by it for "excess diversion" of water, charges for which are authorized by law to be made, and all such funds so turned over or paid directly to the state treasurer shall be shown in his accounts as moneys received on account of charges for "excess diversion" of the water of the state. The commission may retain for its own use the moneys resulting from charges made by it to meet the expenses of hearings as herein provided.

58:1-33. *Certain powers of district water supply commissions and mu-*

municipalities not affected; dams. Nothing contained in this chapter shall be held to affect the jurisdiction, power or authority of any district water supply commission or the power of any municipal corporation or other civil division of the state to acquire by condemnation or otherwise any existing water works system, or to develop, enlarge or improve its existing water supply from its present source of supply, except that for the construction or enlargement of any dam the approval of the commission must be obtained, and except that notice of any taking of additional water shall be given to the commission before work of construction begins, upon which notice the commission may call a hearing whenever in its judgment the necessities and opportunities of other municipalities are affected thereby, and after such hearing the commission may impose such conditions upon such taking of additional water as may be required in the interest of such other municipalities.

58:1-34. *Contracts with municipalities for water supply.* L. 1910, c. 303, p. 546 (C. S. pp. 5803 to 5805, §§28 to 37), entitled "An act to empower municipalities to contract with the State Water Supply Commission for a water supply and raise and advance moneys for the purpose, and to empower the said commission to acquire lands, water rights and water works and construct works necessary to furnish such supply and to sell water and water power in this state," approved Apr. 12, 1910, saved from repeal, together with amendments and supplements thereto approved on the following dates:

Apr. 27, 1911 (L. 1911, c. 245, p. 526; 1924 Supplement §232-37a).

Apr. 27, 1911 (L. 1911, c. 252, p.

533; 1924 Supplement §§232-37b to 232-37e).

Apr. 23, 1915 (L. 1915, c. 394, p. 749; 1924 Supplement §232-33).

[The 1910 act, as amended and supplemented, authorizes the State Water Supply Commission (now the State Water Policy Commission) to contract with municipalities to provide their inhabitants with a water supply, and to construct or acquire the necessary works to furnish such supply. This act does not authorize contracts with municipalities within the North Jersey Water Supply District since at least to that extent the act was repealed by L. 1916, c. 71, §22, as amended by L. 1924, c. 190, p. 411 (see Section 58:5-30 of this title).]

## Chapter 2. Payments to State for Waters Diverted

58:2-1. *Payment in the case of diversion of surface water supplies; exception.* Every municipality, corporation or private person diverting the waters of streams or lakes with outlets for the purpose of a public water supply shall make annual payments on May 1 to the state treasurer for all such water diverted in excess of a total amount equal to 100 gpd. for each inhabitant of the municipality or municipalities supplied, as shown by the census of 1905, or in excess of such greater amount as it may have been legally diverting on June 17, 1907.

The provisions contained in this chapter as to payment to the state for water diverted from surface sources shall not apply to waters obtained from wells, except as provided in Section 58:2-4 of this title.

58:2-2. *Fixing of charges for surface waters diverted; review.* Payment for water diverted as provided in Section 58:2-1 of this title shall be

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deemed to be a license and its amount shall be fixed by the State Water Policy Commission at a rate of not less than \$1.00 nor more than \$10.00 per million gallons. If at all times an amount equal to the average daily flow for the driest month, as shown by the existing records, or in lieu thereof 125,000 gpd. for each square mile of unappropriated watershed above the point of diversion, shall be allowed to flow down the stream, the commission shall fix the minimum rate and may increase the rate proportionally as a less amount is allowed to flow down the stream below the point of diversion, due account being taken in fixing said increase both of the duration and amount of the deficiency. The aforesaid 125,000 gpd. for each square mile of unappropriated watershed shall be additional to the dry-season flow or any part thereof which may be allowed to flow down from any appropriated watershed or watersheds above the point of diversion.

Water diverted within the corporate limits of a municipality for manufacturing and fire purposes only and returned without pollution to the stream from which it was taken within said corporate limits shall not be reckoned in making up the aggregate amount diverted.

Any party aggrieved by the action of the commission upon filing written complaint on or before March 20, shall be heard and permitted to give evidence of the facts, and the sum fixed may be changed, reduced, or canceled, as the facts may warrant.

58:2-3. *Certification and collection of amounts due; state water supply fund.* The State Water Policy Commission shall annually certify to the state comptroller, as soon as practicable after January 1, and not later than

February 15, the names of all municipalities, corporations or private persons owing money to the state for the diversion of water during the preceding year, with the amounts so due.

The state comptroller shall promptly notify said municipalities, water companies or persons of their indebtedness to the state, and if said amounts are not paid to the state treasurer on or before July 1 of the same year, the state comptroller shall certify to the attorney general for collection the names of the delinquents and the amounts due from each, and the attorney general shall take immediate steps to collect the same in the name of the state.

All sums received as herein provided shall be credited by the state treasurer to a special fund to be used by the commission as the legislature may direct for the control of the waters and conservation of the water supplies of the state.

58:2-4. *Payment in the case of condemnation of subsurface, well or percolating water supplies.* In the case of the condemnation of subsurface, well or percolating water supplies, there shall be charged by the state a fee of \$1.00 per million gallons from that portion of the supply for the acquisition of which the state's right of eminent domain is exercised for all water diverted, which charge shall be certified to the state comptroller by the State Water Policy Commission and its collection shall be enforced in the same manner as hereinbefore in this chapter provided in the case of excess diversion of surface water supplies.

58:2-5. *Saving clause.* Nothing in this chapter shall be construed to confer upon any municipality, corporation or person, any franchise not already

possessed by said municipality, corporation or person, but the approval of the commission contained in its decision as provided in this chapter, shall constitute the assent of the state to the diversion of water as against the state in accordance with the terms of said decision.

### **Exercise of Right of Eminent Domain**

#### **Chapter 6. Acquisition of Lands and Water Rights for New or Additional Water Supply**

*58:6-1. Corporations and persons supplying water; approval of plans and assent of state to be obtained.* Every municipal or other corporation now or hereafter organized under any law of this state and engaged in the business of supplying water for public use in one or more municipalities of this state, and any person or persons so engaged, which singly or jointly with other of such municipal or other corporations, or other persons, shall obtain from the State Water Policy Commission or other state agency succeeding to and exercising the jurisdiction and powers of such commission, the approval of plans for and assent of the state to the diversion of water for any new or additional water supply or from any new or additional source or sources of water supply in this state, may acquire by gift, devise, purchase or condemnation all such lands, water and water rights as may be required to enable such municipal or other corporation, or such person or persons, to divert and use water for such new or additional water supply or from such new or additional source or sources of supply in accordance with the plans so approved and the assent of the state so obtained.

*58:6-2. Corporations and persons supplying water; approval of plans*

*and assent of state heretofore obtained.* Every municipal or other corporation organized under any law of this state and engaged in the business of supplying water for public use in one or more municipalities of this state, and any person or persons so engaged, which singly or jointly with other of such municipal or other corporations, or other persons, has obtained from the State Water Supply Commission, the Board of Conservation and Development or the State Water Policy Commission, the approval of plans for and the assent of the state to the diversion of water for any new or additional water supply or from any new or additional source or sources of water supply in this state, may acquire by gift, devise, purchase or condemnation, such lands, water and water rights as may be required to enable such municipal or other corporation or such persons, to divert and use water for such new or additional water supply or from such new or additional source or sources of supply in accordance with the plans so approved and the assent of the state so obtained.

*58:6-3. Approval before condemnation proceedings.* Before the right of condemnation conferred by this chapter is exercised, the approval of the State Water Policy Commission or other state agency succeeding to and exercising the jurisdiction and powers of such commission, shall be first secured thereto.

*58:6-4. Law regulating condemnation proceedings.* In the event of the exercise of the power of condemnation conferred by this chapter, the proceedings therefor shall be had pursuant to the provision of Chapter 1 of the title Eminent Domain (§20:1-1 et seq.).

*58:6-5. Power to condemn under existing laws not affected.* Nothing contained in this chapter shall limit or

in any way affect any power to condemn lands, water or water rights which any such municipal or other corporation or person may now have or hereafter acquire under any existing law of this state, and such power so to condemn may be exercised as though this chapter had not been passed.

## Contracts Between Municipalities

### Title 40. MUNICIPALITIES AND COUNTIES

#### Chapter 62. Public Utilities Municipally Owned

#### Article 8. Water Supply

40:62-84. *Contracts to supply other municipalities; approval.* The governing body of any municipality owning

or controlling water works may enter into a contract or contracts with any other municipality to furnish a supply of water to it and its inhabitants, for public and private use, for the term of a year or years, provided, there shall first be obtained the approval of the state board or department having jurisdiction of such matters, which approval the board or department may withhold or grant upon such terms as it may deem proper. If approval is withheld the reason therefor shall be furnished by the board or department to the municipality applying therefor. All such contracts to be binding upon the municipality supplying water, shall be approved by the general legislative body of the municipality and the mayor or other chief executive officer thereof.

### Order M-38 as Amended March 31, 1945

The War Production Board Tin, Lead and Zinc Division has issued General Preference Order M-38, as amended Mar. 31, 1945, banning the use of lead or lead products except for certain items listed with the order. Such use is permissible then "only to the extent necessary to meet applicable specifications or for the proper service performance of the end product or where the use of any less critical material is impracticable or when satisfactory substitutes are prohibited in other War Production Board orders." Items in the list particularly related to the water works industry are:

15. Calking of cast-iron pipelines (including lead wool) where other material such as sulfur compounds or cement does not provide a leak-proof joint.

47. Sheet, pipe (including lead-lined pipe), valves, fittings, burning bars and castings to be used . . . in water service lines to the extent that municipal, state or federal regulations permit no substitutes or sound water works practice requires its use.



## Policies in Postwar Planning of Water and Sewage Works

By Harry E. Jordan

Secretary, Committee on Water and Sewage Works Development, New York, N.Y.  
Presented on Mar. 21, 1945, at the Canadian Section Meeting, Toronto, Ont., Can.

ONE of the leading bankers of England, the Hon. Rupert E. Beckett, Chairman of the Westminster Bank, Ltd., in his annual review of economic conditions at the end of 1944 made the following statements which relate strikingly to the subject matter of this discussion:

With the whole industrial machine still working for the war effort it is nevertheless opportune, in view of the approach of the end of the war in Europe, to make preparations for the transition from war employment to peace employment. No nation can undergo the ordeal of war, and especially of this war, without impoverishment and economic exhaustion, and those well-meaning people who imagine that we shall, as a nation, emerge better equipped and ready for a triumphal entry into a new world will, I fear, be sadly shocked by the realities of international devastation and dislocation.

Industries and businesses, both big and little, whose normal activities have been diverted and adapted wholly or in part to purposes of war, will need adjustment to, and equipment for, the resumption and extension of their peacetime activities. Not only have we had to hold in abeyance all the work that would normally have been fulfilled during the years of war—in itself a colossal accumulation—but we shall also have to repair all that has been broken down and destroyed during the war years in every department of our social and national life. In short, we have three tasks to combine in one. To catch up the arrears; to restore the wartime damage; and to reconstruct anew. The immensity of the task will be apparent to everyone, and when we remember that the same tasks confront all the nations of Europe

and elsewhere, it will be seen that work to the maximum extent, and with the greatest energy and concentration, is ahead for many years.

While in North America the restoration of wartime damage to property is not a direct problem, we do face its effects in the drain upon the capital and manpower resources of the allied nations. We do face just as sharply as Britain the problems of catching up arrears and of constructing anew.

No previous conflict in the history of mankind has ever demanded and received so great a tribute in materials and in human lives. Never before has the world so greatly readjusted its productive capacity to serve the needs of making war. Likewise the world has never before faced so universal a problem of readjustment to peacetime pursuits.

It was the recognition of this tremendous readjustment problem that led American industry and business—almost before it set itself completely into war production—to begin its thinking about the problems of demobilizing industry and labor and even of demobilizing a national government geared to control the people in time of war.

The Committee for Economic Development, for example, already has behind it two years of organization of

thinking of manufacturers and business men to the end that they may be able to marshal the production and distribution forces of the country for the materials and employment in a peacetime economy.

But the CED is but one of the many postwar planning groups operating at national, state or local levels, all determined that, when the war is done, people shall not suffer mass unemployment and the people's needs shall be met by production of goods and the construction of all the factories, stores, homes and public works that they have not been able to build during the war years.

Water supply and sewage works have found a way to focus attention upon the need for more and better water supplies and more adequate sewage treatment through the Committee on Water and Sewage Works Development. Conferences, begun early in 1943, were able to develop a basis upon which the associations having a major interest in water and sewage works could join in promotion of planning needed construction when the wartime restrictions were lifted. The initial meeting of duly appointed representatives of the American Water Works Association, the American Federation of Sewage Works Associations, the New England Water Works Association and the Water & Sewage Works Manufacturers Association was held in July 1943. Abel Wolman was selected to act as chairman of the committee and the author to act as secretary. The work that was done in 1943 and 1944, especially as related to the valuable services of E. L. Filby as Field Director, is well known. Mr. Filby's account of his promotional activities has been published in this JOURNAL [36: 725 (1944)].

No field activities are now carried on by the committee, but a bulletin entitled "Blueprint Now—In Action" is published at frequent intervals and is distributed to all water and sewage works executives in cities of over 2,500 population in the Dominion of Canada and the United States. Any person interested in the subject can receive the bulletins if he requests them.

The present objectives and policy viewpoints of the committee have been carefully outlined in a report made by the author to the constituent associations as of Nov. 30, 1944. They are repeated here.

1. The basic objective of the Committee on Water and Sewage Works Development is reaffirmed—to promote, among water and sewage works executives and the municipal administrators responsible for public works planning, the full realization of the value to the community of BLUE-PRINTING NOW all needed water and sewage works construction, to be done as soon as wartime restrictions are lifted.

2. The committee will continue its policy of being a morale building agency, but not a selling agency. It considers its function to be the development of an aggressive attitude among water and sewage works executives which will lead them, in their own service areas, to promote and plan useful water and sewage works construction. It does not consider that its function is to engage in the promotion or development of specific projects. To whatever extent the local executive needs aid of this character, it can be obtained through the activities of the consulting engineer on the one hand and the sales forces of water and sewage works manufacturers on the other.

3. The committee will not engage in

the collection of statistics as such. It recognizes the interest of already-existing long-term agencies in the collection of data related to construction and planning. Persons having need for organized statistics concerning planned construction in the water and sewage works field should obtain their information from such agencies.

4. The committee, in its initial statement of policy and objectives, issued Aug. 15, 1943, said:

We do not believe that we have to wait for federal aid, either for the planning or for the execution of useful public works. The federal aid policy of the thirties was a major contribution toward the nation's recovery from a serious economic depression and did much to bring water and sewage works to communities whose depression-period need for them was great and whose ability to fund them was lacking. But the conditions of the immediate forties differ in many ways—in particular because of the fact that both municipal construction and maintenance have deliberately been substantially deferred during the war period while national income has grown to heights never before attained. Thus we can but feel that waiting for federal aid, either in planning or in execution of any public works, can only breed the necessity of having it; while the forthright local progress in planning as well as execution of public works, under the conditions and with the freedom in which American cities for generations carried on such work, will restore the true responsibility that every city and region has for putting its affairs in order and its public works program into effect. We perceive no substantial evidence that American cities need federal aid to put their water works and sewerage programs into action, but rather that the weight of evidence is to the contrary.

5. Since this statement was issued, it has become evident that the laws in many states, which prohibit the incurring of planning expenses until cash to pay for construction is in hand, make it necessary that the incentive of loans or grants for planning expense be made effective. This has been done to greater

or lesser degree by state legislation in California, Maryland, Michigan, New Jersey and New York and is contemplated (but funds not yet authorized) through federal loans by the terms of the War Mobilization and Reconversion Act of 1944.

6. The committee recognizes the merit of federal loans of reasonable magnitude to municipalities in order to permit them to develop plans for post-war public works and recommends that, if such loans become available and will make it possible for a community to plan public works which could not otherwise be planned, they should be negotiated.

7. The committee, however, still holds the opinion that water works and sewage works construction projects, *during the immediate postwar period*, can be financed by the great majority of cities, towns and districts which have need for them. It does not doubt that there are exceptions to this rule, but it does not accept the idea that the inability of a minority of cities should be the basis of grants-in-aid for other than such minority, and then should be based on proof of valid justification.

8. At the end of 1944, the evidence is clear that as soon as wartime restrictions are lifted, the demand for consumer goods, housing and the like will rise to great proportions. This will automatically encourage rehabilitation of water and sewage works facilities as well as additions to existing works to serve new housing and industry. But, there is danger that the desire to provide immediate postwar employment will lead some to overlook this great demand for consumer goods and to promote a program of federal grants-in-aid which will collide in timing with the great demand for consumer goods and services.

9. To superimpose a program of federally-aided public works upon the spontaneous demand for consumer goods and the capital investments related thereto is to plan the road to a depression of greater severity than any previous one experienced in America. This is a time for realistic thinking and realistic thinking will not force a depression by premature timing of federal aid.

10. If, after the peace has come, the natural course of enterprise does not maintain a level of adequate employment and it becomes a matter of national policy for the federal government to engage in subsidization of public works, then this committee agrees that water works and sewage works have such immediate and permanent values in the scale of living that they should commend themselves to those in authority as enterprises to which the federal government can properly give support and aid.

#### **Interpretation of Committee's Attitude**

The support given by this committee to loans for planning postwar construction is a recognition of the fact that, in spite of everyone's full knowledge that public works cannot be put into construction without prior planning and approval by governing bodies, many cities will not put their public works thinking into the planning stage without some incentive. It is also true that laws in many states prohibit expenditures for planning until cash for construction is in hand. Again many state treasuries are in possession of large reserve funds which can be distributed upon a population basis to defray the cost of postwar planning in an effort to reduce unemployment during the immediate postwar years.

Since several states have already put into effect the policy of grants-in-aid to communities for postwar planning, and further, since the federal Reconversion Act has established the policy of loans for postwar planning, the committee is not inconsistent when it accepts these existing policies and emphasizes the priority of water and sewage works in the public works field.

The committee is likewise consistent in its tenth item of policy which is to support grants-in-aid for water and sewage works construction *when* unemployment becomes a national problem and *when* it becomes a national policy to support public works by grants-in-aid. The representatives of the constituent associations are unanimous in their support of this position but at the same time are unanimous in their approval of the seventh item of policy, namely, "water and sewage works construction projects, during the immediate postwar period, can be financed by the great majority of cities which have need for them." The official bodies of the four associations have approved the statement of principles and policies.

The Committee on Water and Sewage Works Development has, so far as the opportunity reasonably offered itself, advocated no waiting or wishing for grants-in-aid to construct water and sewage works. It apprehends that the great majority of water works and sewage works executives would prefer to see the postwar construction program go forward upon a self-starting and self-liquidating basis. It would appear that with the inevitable upsurge of construction after the war's end, the non-intervention of grants-in-aid would stabilize the national economy at a more practical level.

It is granted that loans or grants-in-aid for planning either from the states

or from the federal government can help get blueprints into process. That is an indirect form of unemployment relief, and should be, if at all possible, upon a loan basis. The committee has no reluctance to be understood as advocating high priority for water and sewage works grants-in-aid if unemployment should ensue and a federal public works program be initiated. If and when it becomes a national policy to attempt the restoration of the economic balance by stimulation of public works, we would not have anyone assume that water and sewage works construction is one whit less important in the national and local economy than any other type of public works.

The committee views the work that it has been able to do with appreciation of the fact that it could have done more. It could have spent more money, set up staffs in every state, deluged the cities with propaganda. Perhaps it was a mistake not to do those things. I do not think so. We do know this: During the past two decades water works and sewage works construction has made up 2.6 per cent and 4 per cent respectively of the total public works program in the United States.

It is highly essential for persons interested in water supply and sewage works to keep in mind the fact that, while these services are important parts of American public works, their dollar volume in the year by year record of public works construction is much less than roads and streets, bridges, buildings, etc.

It is highly gratifying to observe that as of Mar. 1, 1945, the American Society of Civil Engineers Postwar Construction Committee's summary shows that of public works construction plans under way, water works made up 6.8 per cent and sewage works 13.7 per cent. Collectively, the two services are shown to be in the planning stage at more than three times their normal proportion in the entire public works field.

The committee will continue its efforts to keep the rate of water and sewage works planning in advance of the field. It will review, as often as appears fruitful, its policies and program, and will, as long as its work continues, attempt to relate itself and its activities realistically to the postwar objective of us all—full employment at useful production in a free world.

#### OBSERVATIONS CONCERNING FEDERAL AID

Since there has been and continues to be a substantial amount of discussion concerning federal grants-in-aid as a part of the postwar planning program, it seems proper for the author, *as an individual, and not as a spokesman for the committee*, to record his opinions on the subject.

Those of us who have our inhibitions about federal aid as a permanent policy tend at times to overlook the fact that certain types of federal aid are not new. The real distinction is the effect

of the new types of federal aid on municipal and state functions.

In 1790, following the adoption of the constitution, the U.S. government assumed the debts of the constituent states totaling about \$18,000,000. These debts had largely been incurred in prosecuting the war of separation from England. It is, however, interesting to be reminded that the step was taken at the insistence of Alexander Hamilton, who saw in it a means of strengthening the federal govern-



ment as against the states. The debt assumption was not a grant in the current sense, but it must be recorded as the first federal intervention (after the adoption of the constitution) in state fiscal affairs.

In 1836, the federal government found itself out of debt with a surplus of revenue. These funds (about \$28,000,000) were distributed on a quasi-population basis to the states. It will be remembered that many of the states in the thirties were engulfed in gigantic (for those days) internal improvement programs.

As early as 1785, Congress, then meeting under the Articles of Confederation, began the practice of granting acreage from the public domain for public schools, for universities and for public improvements. In 1857, the Morrill bill was introduced. It intended to bring about the donation of land to each of the states for the endowment, support and maintenance of at least one college whose leading object would be the teaching of agriculture and mechanic arts. The bill was violently opposed by the southern members of Congress (the states rights area) and did not become law until 1862, after the war between the states had begun.

In 1916 federal aid was extended into the highway field and in 1918 into the public health field (venereal disease control). In 1935 came the extension to dwarf all others—the Social Security program.

In dollar amount, in 1942, federal aid in the field of agriculture amounted to \$438,000,000, in highways \$140,000,000, in public health work \$19,100,000 and in the various social welfare activities, including child welfare and aid, public housing and old age assistance, \$388,000,000.

The public domain states as early as 1820 forced the establishment of the principle of federal aid in lieu of revenue which the states claimed they would have had if the public domain were privately-owned land. For almost a century this amounted only to a 5 per cent share from the sale of public lands, but since 1908 revenues from national forests, annual leases, grazing, etc., have been returned in part (25 to 50 per cent) to the states. This amounted in 1942 to \$5,225,000. Such projects as the Tennessee Valley Authority now have established the practice of paying a portion of their income to states and their political subdivisions to balance the loss from taxes on private property taken over.

When the depression of 1929 came, the federal program moved beyond the "aid" basis, where the state re-disbursed the funds, to the "grant" category, that is, direct disbursement of federal funds to municipalities or districts and directly to or on behalf of individuals. Under this heading are the Agricultural Adjustment Program, the Farm Security Program, the Civilian Conservation Corps, the National Youth Administration, Emergency Relief, Works Projects Administration, Public Works Administration and Emergency Highways. Under these headings, the federal disbursements in 1934 were \$2,490,800,000, in 1937 were \$3,598,900,000, and in 1940 were \$3,220,300,000. During the war, several of these programs have been terminated, but there is evidence that pressure will be brought to re-establish many, if not all, of them when the readjustment period comes after victory.

From the valuable study of "Federal Grants-in-Aid" published by the Citizens National Committee of Washington, the discussion above has been con-

densed. The concluding section of that study admirably epitomizes the pros and cons of federal aid:

Notwithstanding earlier traditions, now shattered, federal aid to the states seems to be accepted as a basis of tax equalization among the states and as a means of establishing reasonable standards in various activities and social features in low income states.

Opposition to federal aid is largely on the ground that the federal government should concern itself with matters of purely national concern. Opponents insist that functions, for which grants are made, are purely local in scope and nature. Of course a function is not inherently national or local. Highways, once a local function, are now a national one. It is difficult, however, considering the form of government, presently to identify agriculture, education and the relief of the needy as national functions. Public health may also be classed as a local interest, except in matters of interstate concern.

A further argument against federal aid is that it stifles local initiative and responsibility. It may be pointed out, on the other hand, that initiative has sometimes been increased, and often states have committed themselves beyond their means in order to avail of federal funds. The subsidy system was devised to retain operations and control in the hands of state officials, but it has largely developed with an ever-expanding federal power. With federal money goes federal control and the conditions and limitations have been increased and strengthened with each new grant. In fact, federal bureau chiefs now exercise a veto over many state activities. The effect is to coerce the states.

So this leads back to the question of what is or what should be of national concern and what should be local. There can be little doubt that state self-reliance and resourcefulness, as well as states' rights, have been reduced and infringed as a result of federal aid. And as an attempt at equalization or standardization, federal aid cannot be an unqualified success. Inequalities must always remain, since many factors other than money must be taken into consideration.

What has occurred is a rupture between fiscal control and our original political forms. As a result, deterioration of the political forms, both state and national, has spread far beyond the limits of mere taxing and

spending—for loosened control of the purse is symptomatic in many directions. The "leverage" which the federal government can now exert on the states, particularly through the indirect grant, introduces political factors with which, thus far, we have no effective means of dealing.

The extension of the separation of fund-raising processes from the responsibility for intelligent expenditures on the part of those citizens in whose interest the expenditures are being made is inherently a denial of the validity of "government of the people, by the people and for the people."

The taking under national control as a continuing and permanent policy the discretion to construct public works, the usefulness of which is local or regional, sterilizes the basic principles of democratic government and emasculates the citizen's responsibility for keeping his body politic and economic in order.

It is, however, a temptation to public officials which only the more rugged are able to resist. The states have, as we know, absorbed many of the newer forms of fund raising through taxation and left to municipalities little fund raising power beyond the real estate tax to draw upon for city uses. So when it becomes known or even hinted that federal funds may be made available for public works construction, it is easy to blind one's self to the damage done to principles of government and accept the federal grants for projects whose function is local or regional—for projects whose construction should be based upon the willingness of the user, the citizen, to pay the cost. Whatever may be said in support of the propriety of accepting federal grants for projects of local value by cities whose taxing power is not able to meet the financial strain, public water supply, practically universally, and sewage

collection and treatment, in most states, need not be a drain upon the taxing power. The revenue bond principle makes it possible for water and sewage works to be constructed and paid for by revenue derived from the users of the water and sewage service.

Our consideration of these matters at this time is not merely academic. There are before the Congress today certain proposals which would extend the federal grant principle into the field of water and sewage works construction, not as an element in an emergency employment program in times of nation-wide unemployment, but as a continuing federal policy.

### The Pepper Report

The Senate Committee on Education and Labor, through its Subcommittee on Wartime Health and Education, headed by Senator Pepper of Florida, made in its interim report dated January 1945 a series of recommendations, three of which are of interest to public water supply officials. The subcommittee:

Recommends that federal grants-in-aid to states be authorized now to assist in postwar construction of hospitals, medical centers and health centers, in accordance with integrated state plans approved by the United States Public Health Service.

Urges state and local governments to establish full-time local public health departments in all communities as soon as the needed personnel become available. With this aim in view consideration should be given to rearrangement and consolidation of local health jurisdictions and to amalgamation of existing full- and part-time local health departments with overlapping functions. The federal government should increase the amount of its grants to state health departments to the end that complete geographic coverage by full-time local health departments may be achieved and that state and local public health programs may be expanded in accordance with needs.

Recommends that federal loans and grants be made available to assist in postwar provision of urban sewerage and water facilities, rural sanitation and water facilities, and milk pasteurization plants, in communities or areas where such facilities are lacking or inadequate.

Here we have the "social security" principle of federal interest in the health and welfare of the people, proposed to be extended upon a permanent basis into a group of activities which will involve billions of dollars in federal funds and which have traditionally been matters of local and state responsibility. Although this might be discussed extensively, one is led instead to certain simple questions: What do the proponents of these recommendations consider to be the remaining functions of the states and of the cities? Have we knowingly abandoned or are we unconsciously abandoning the principle of responsibility of the citizen for the support, at the level benefited, of the services rendered to him? Have we, in the midst of a war against totalitarianism, reached the attitude that the national state is our master and, as such, responsible for our employment, our health, our welfare?

Returning to the committee report, we find the following suggestions made by it which relate directly to our field of interest:

The progress made in the control of filth and water-borne diseases should not blind us to the fact that many communities lack adequate sanitary installations and that rural sanitation in many parts of the country is at a deplorably low level. According to the United States Public Health Service, nearly 5,000 communities need new water systems and approximately 6,500 need water extensions or improvements. New sewerage systems are needed in about 7,700 communities with a combined population of nearly 9,000,000. More than 10,000,000 additional people live in communities where sewer extensions are needed. There are more than 2,800 in-

corporated communities with a total population exceeding 25,000,000, that do not have any form of sewage treatment. Approximately 5,250,000 rural homes need new or improved water supplies, and 5,000,000 need sanitary privies. More than 846,000 rural homes are without any toilet facilities whatsoever.

In many instances, community facilities such as those mentioned above could be financed on a self-liquidating basis by local governments with the aid of technical assistance and long-term, low-interest loans from state and federal governments. In other cases, grants-in-aid would be needed to supplement local resources. Such loans and grants would pay high returns in better health for all the people and in civic improvement throughout the nation. Moreover, the required projects would give substantial stimulus to industry and would help provide full employment after the war.

### Water Works for Small Places

The temptation is great to discuss these statements in detail. Upon one, which has been repeated often, some comment must be made. It is the statement that 5,000 new water works systems are needed in U.S. incorporated communities. This appears to be based upon the Streeter-Raneri "National Inventory of Needs for Sanitation Facilities." In that report there is a tabulation which lists "Incorporated Communities Considered for New Water Works." In the tabulation are shown, by states, the number of communities which have no public water supply. For the entire country there are shown to be 149 incorporated communities of over 1,000 population which have no public water supply. In the 500-1,000 range there are 797 and in the under 500 range there are 3,820 communities without public water supply. The total is 4,766.

This is no setting in which to depreciate the value of public water supply. Water piped into any home and available for all domestic uses and for

limited fire protection is a desideratum in modern life. Our British contemporaries, in the Lord Justice Scott report, have opined that: "we consider the provision of a piped water supply an essential service in every village and on every farm and a desideratum in every dwelling."

In another current report of the same British series is found this statement: "Every effort should be made within a period of years to provide, as a minimum, a piped water supply to communities of approximately 250 persons resident within a quarter-mile radius, unless it is found in any particular case that the cost is prohibitive." Hoskins of the U.S.P.H.S. uses the figure of 200 persons as the minimum.

The water works engineer has a responsibility to himself and to the people he serves to appraise calmly these statements both of British and American origin. Piped water is an asset to every household. No one questions that today, yet few of us over fifty enjoyed such a thing when we were youngsters. But a domestic water supply under pressure in the house in the village is one thing and a publicly-produced and -distributed supply is another, if we still consider the economics and engineering practicability of the enterprises we recommend. What is the reasonable lower limit of population in which a public water supply is practical and for whom a domestic pressure supply is a disservice?

Our British friends suggest 250 persons—with careful reservations. I shall venture, with a little knowledge of the problems existing in certain PWA water supplied communities, to suggest that for population groups of 500 or less a centrally-piped water supply is quite a venture. I should look

with some apprehension upon the problems which might easily develop in many communities of less than 1,000 population which today have no public supply. The same Streeter-Raneri study shows 4,438 less-than-1,000 population communities which in 1940 had a public water supply. Shall we not say that care should be taken to develop social responsibility and administrative capacity among the people in the other less-than-1,000 population communities, before pressuring them into such projects—even with the bait of federal aid? It simply boils down to this: the fact that a community is incorporated and has X people in it, is not *prima facie* evidence that it needs a public water supply or could run it, if it had one.

The values of a public water supply are manifold. Water works engineers have a responsibility for encouraging in every possible way the construction of public water supply facilities in communities which do not now have them but which are able to support them. They have a like responsibility for objective appraisal of the ability of a community to support a public water supply. If that ability does not appear to exist, encouragement should be given to providing piped domestic water supply as well as the use of fire-resistant building materials and the obtaining of fire-fighting equipment which does not require a large volume of water to make it effective.

These observations upon the minimum size of community capable of supporting a water system are completely pertinent to the basic objectives of the Committee on Water and Sewage Works Development. It must advocate the construction of public water works wherever they can be supported by the users, but not where there ap-

pears to be a lack of local leadership and management ability.

In a measure, these comments are not closely related to a discussion of federal grants-in-aid except that they may make us aware of one important fact. Federal grants-in-aid for any socially desirable purpose tend to unbalance the economic sense of both the grantor and the receiver of the aid. No real service is rendered to a village or town by thrusting upon it via the grant-in-aid route any public works project which the village or town cannot support after it is built.

### **Bills for a Water Pollution Control Agency**

More concrete, presently, than the Pepper subcommittee report, is a series of bills in Congress designed to extend the authority and activity of the U.S. P.H.S. in the control of stream pollution. H.R. 519 (Mundt), H.R. 587 (Smith) and H.R. 592 (Spence), as well as S. 330 (Brewster), cover the same general proposals in varying terms. The bills would set up a Federal Division of Water Pollution Control and outline steps to be taken by such division in the control of stream pollution. All involve the federal grants-in-aid principle as a mechanism to procure the construction of sewage treatment works which have been ordered by the Water Pollution Control Agency. S. 330 and H.R. 592 are approximate parallels and are constructive legislation in so far as they promote a federal-state co-operative program to improve the condition of streams. If there could be eliminated from the bills the section (2-d) which confers upon the federal agency the power to act whenever the state has failed to take satisfactory action as promptly as the federal group desires,



the proposed legislation would appear to have constructive value.

But the adoption of the grants-in-aid principle even for this worthy purpose, as a permanent part of national policy, not related to unemployment relief, is in the judgment of the author just as improper as are the other intrusions of federal funds into local and regional problems.

This must be said. There are certain definite interstate stream pollution problems which are serious and indefensible. The states concerned have the power now to enter into compact arrangements to correct the conditions which exist. For one or another reason of doubtful validity, the compact authority has not been set up. If it is not set up soon, federal legislation will be enacted which will be of the pattern now before Congress. The states cannot stand upon the theory of the rights of states and continue to fail to exercise those rights and meet the responsibilities which those rights entail. It is not consistent with the traditional concepts of the functions of local, state and national government to deal with local or regional problems at the national level. But if the problems are not handled at the local, state or regional level, they will inevitably, in the general public interest, be handled at the national level.

### National City Bank Bulletin

Supporting these opinions are statements contained in the National City Bank Bulletin for February 1945 and in the brochure, "Stabilizing the Construction Industry," written by M. L. Colean and issued by the National Planning Association early in 1945. Quotations follow:

The conclusion of the war threatens to let loose the greatest concentrated spending in

the history of states and municipalities. Among the many problems involved are two of general application: first, the timing of this spending to obtain the maximum national benefits in supplementing rather than competing with private employment; and second, the temptation to continue an unwarranted reliance upon the federal treasury for the financing of public works.

In a recent bulletin, the Bureau of the Census estimated that the gross indebtedness of states and municipalities on June 30, 1944, amounted to \$17,400,000,000. This was the second consecutive year in which debt had been reduced by about \$1,000,000,000. The peak figure was reached on June 30, 1940, when total debt amounted to \$20,200,000,000.

At that level it was approximately twice the 1922 figure and ten times the 1902 total. The reduction since 1940 amounts to \$2,800,000,000, or 14 per cent. Of the present amount, states account for \$2,768,000,000, or 15.8 per cent, and municipalities for \$14,703,000,000, or 84.2 per cent. About \$1,685,000,000 is classified as "revenue" debt. The above figures are gross and do not take into account sinking fund assets. These totaled \$2,473,000,000, or a net debt position of \$14,927,000,000 for all states and municipalities on June 30, 1944.

It is to be hoped that the planners will swing more and more toward projects which can be fully financed by the states and their subdivisions. The federal aid policy ought to be re-examined in light of the war debt now loaded on the federal treasury and of the vast improvement in the finances of states and municipalities. It is only logical that they be called upon for full support of essential projects, while the federal treasury has the duty of getting its own debt in order.

If we assume a good volume of business activity after the war, states and municipalities will have some additional borrowing power. Their problem will be to use it wisely; not to waste it; not to accentuate an inflationary surge; not to compete with enterprise for men or materials; but to use it at times and in ways that will aid in business stability and contribute the maximum to the people's well being. This will take great restraint.

### National Planning Bulletin

Quoting from "Stabilizing the Construction Industry," by M. L. Colean:

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"It is fundamental in considering governmental participation that we adhere to the principle, stated in the National Planning Association's Declaration of Inter-Dependence, which reads as follows:

The basis of America's postwar economy should be private enterprise, with private business and industry and agriculture the people's primary means for providing jobs and producing goods and services; with government performing its constitutional function of establishing the rules of the game, acting as impartial referee, and effecting fiscal policies through taxation and expenditure programs, such as public works, that will mesh with private undertakings.

This principle may, for purposes here, be elaborated in these specific terms:

1. Since the volume of construction under all but the most exceptional conditions (such as war and depression) must be derived principally from private construction, the national policy should be such as to enable industry to make wise decisions and to guide its activity in the areas of the greatest potential demand.

2. Action taken by government (whether federal, state or municipal) should so far as possible be supplementary to private activity and should be designed not only to produce, when necessary, additional construction employment or additional volumes of building but at the same time to restore or stimulate private construction.

## Conclusions

The preparation of this statement relating to policy in the promotion of water and sewage works improvements has been more than the simple act of preparing something to be delivered and perhaps later to be read. It will be alleged by some who have from time to time differed with the author's opinion in such matters that he has spent much time in rearranging his prejudices—for he finds himself still a believer in the ability of the people to find out what they need and what they are able to pay for and still not a believer

in the existence of a super-race in Washington or Ottawa or London.

It has made it necessary to obtain a better understanding of the history of aid given the states and their citizens by the federal government. It is, as a result of that study, clear that federal aid is older than the republic, but just as sharply clear is it that the traditional method of federal aid through agencies existing within the framework of state government is not the recent form which flowered to its fullest in the Social Security Act of 1935. In the traditional form, federal aid was a means of disbursing nationally accrued funds to the states upon a per capita or reasonably equivalent basis to be expended by state agencies. The modern or new form of federal aid (apart from emergency unemployment relief) goes directly from the federal government at federal discretion through or to federally administered or controlled disbursing agencies at state or even local levels. The study has in no way diminished the belief of the author in the ability of cities to meet their responsibilities to themselves in the field of water supply and sewage works.

It is evident that the planning of public works of all types has been retarded by the drastic emphasis of "the war comes first" as a national policy. That emphasis is correct. It will at the proper time, or not too long after, change to an equal emphasis concerning "Blueprint Now" for peace and all its works, both public and private. Not so clear is the evidence concerning the ability or willingness of the federal agencies to let the people, to let industry and labor, to let the states and the cities and the people try their hand again at the job they have done before—make America click.

# Operating Experiences at La Verne Softening Plant

*By Lee Streicher*

Chief Chemist, Softening and Filtration Plant, Metropolitan Water Dist. of Southern California, La Verne, Calif.

Presented on Oct. 25, 1944, at the California Section Meeting, Los Angeles, Calif.

EARLIER papers and reports (1, 2, 3) have described in detail the design and construction of the Colorado River Aqueduct and its appurtenances. In this paper, therefore, it will suffice merely to review a few features pertinent to the operation of the softening and filtration plant.

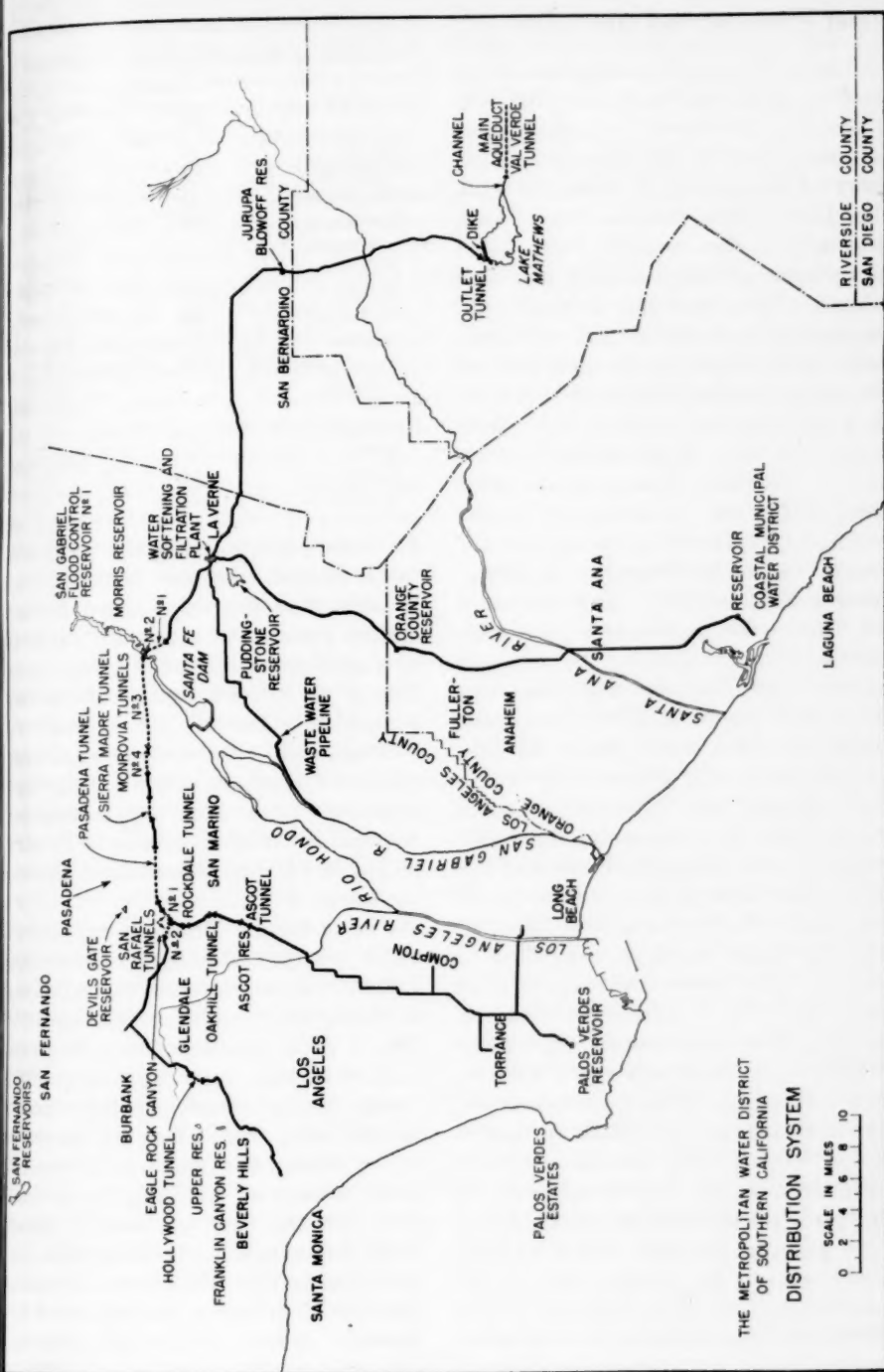
## Design and Construction

In the accompanying map, it may be seen that the softening and filtration plant is located on the upper feeder of the distribution system near the town of La Verne, about 30 mi. east of Los Angeles. The main aqueduct bringing in the Colorado River water is designed and constructed for a capacity of 1,500 cfs., and terminates in Lake Mathews, 36 mi. east and south of the plant site. This is the principal terminal storage reservoir, having a present capacity of 107,000 acre-ft. or about 35 bil.gal. From the reservoir, about 36 mi. of 116- to 152-in. pipeline carry the water to the plant. The upper feeder continues on from the plant in a westerly direction, passing through the member cities of Pasadena, Glendale, Burbank, Los Angeles and Beverly Hills, and terminates at Santa Monica. Deliveries to San Marino are to be provided through a short lateral. The Palos Verdes feeder, ex-

tending from the upper feeder at Eagle Rock Canyon, provides for deliveries to Los Angeles, Compton, Torrance and Long Beach. Another line, connecting to the upper feeder through a turnout structure near the softening plant, provides for deliveries to the Orange County member cities of Fullerton, Anaheim and Santa Ana and to the Coastal Municipal Water District, which includes the city of Laguna Beach.

Although the main aqueduct, except for the installations in the pumping plants and for a number of siphons, is constructed for its ultimate capacity of 1,500 cfs., the softening plant was designed to have an initial capacity of 100 mgd. or 155 cfs., and a future capacity of 400 mgd. The flocculating basins, settling basins, filters, zeolite softeners and salt storage facilities were designed for initial capacity with provision for future expansion. All other features were designed for either half or ultimate capacity.

The aqueduct was built to supplement existing water supplies of the member cities of the Metropolitan Water District of Southern California. Because it is a supplemental supply, the flow rate is quite low during the rainy season but approaches plant capacity during the dry summer months.



## Plant Processes and Operation

After a thorough investigation of all modern water softening methods and extensive experiments at the water softening plant in Boulder City, Nev., where Colorado River water is used, the lime-zeolite process was finally selected as the method best suited and most economical for use with this water. The probable average and maximum hardness of natural Colorado River water to be delivered to the softening plant was estimated from data accumulated by the U.S. Geological Survey, from detailed analyses of Colorado River water made since 1925, and from further analyses made by the District staff in the course of the preliminary investigations at Boulder City. Due allowance was made for evaporation in canals and reservoirs, leaching in concrete pipelines and tunnels, and other factors which might tend to change the character of the water during its 280-mi. trip from the Colorado River to the softening and filtration plant at La Verne. Unfortunately, the hardness and dissolved solids content of the river water was at a maximum at the time Lake Mathews was first filled, so that the plant has been compelled to treat a water appreciably harder than estimated. It is anticipated that the quality of water pumped into Lake Mathews will eventually reach the predicted average. Table 1 compares the estimated average and maximum analyses of natural Colorado River water with the average of that delivered at the plant during the last three years.

In passing through the plant, the water was to be softened to a total hardness of from 85 to 100 ppm. This was to be accomplished by the lime-zeolite process as follows: (1) All of

TABLE 1

### Analyses of Natural Colorado River Water

Constituent	Estimated Average ppm.	Maximum ppm.	Actual Average ppm.
Silica	10	10	6
Calcium	81	111	96
Magnesium	25	30	33
Sodium and Potassium	87	110	125
Bicarbonate			138
Sulfate	243	379	378
Chloride	60	80	100
Nitrate	2.8	3.7	0.4
Total Dissolved Solids	600	804	807
Hardness as CaCO <sub>3</sub>			
TOTAL	305	400	375
Carbonate	145	130	113
Non-carbonate	160	270	262

the raw water entering the plant was to be treated with just sufficient lime to neutralize the free carbon dioxide and to reduce the carbonate hardness to a minimum; (2) all the water was then to be filtered and a portion carbonated to a suitable pH and softened to a nominally zero hardness by passage through the zeolite beds; (3) the lime softened water and the lime-zeolite softened water were then to be blended to give a finished water of the desired hardness.

The softening process, as outlined above, was put into operation when the Colorado River water first entered the softening plant in the early summer of 1941. After a few months of operation, it became apparent that a slight change in the softening process would be desirable. Difficulties are generally to be expected when a new type of water enters an old distribution system. In the case of District water these difficulties might have been expected to be multiplied because several different distribution systems were involved. Some complaints were received soon after softened and filtered



Colorado River water entered the pipelines of the member cities, most of which had been in use for many years, with a water quite different in character from that of the District finished water. Each member city distribution system was lined with deposits and growths suited to the existing environment. When the lime-zeolite softened water of very low alkalinity entered these lines, the environment was so changed that the old deposits were no longer compatible with the new conditions. The result was a sloughing of the old deposits and growths. This, in turn, led to some complaints of bad taste and red water. It was found that these complaints could be avoided simply by removing only a portion of the carbonate hardness by the lime treatment and thereby leaving the alkalinity of the water relatively high—more nearly that of the water previously put through these lines by the member cities. This change in the softening process naturally put a greater burden on the zeolite beds, since the lime was now used to remove only about from 40 to 50 ppm. of the carbonate hardness, whereas it had previously removed from 80 to 90 ppm.

The partial lime treatment was continued until the flow through the plant was at a minimum during the winter season. Under these conditions, with the plant operating at less than 10 per cent of its capacity, it was found less troublesome to eliminate lime treatment entirely and use only the zeolite units for softening the water. The operation of the flocculator paddles and of the Dorr scrapers in the clarifiers was discontinued, and carbonation, necessary when lime treatment was used, was eliminated. Upon increased demand for water in the summer months, particularly during the peak

demand periods in July and August of 1944, partial lime softening was resumed because of the greater economy of this method of softening at high rates of flow.

One other benefit derived from the suspension of lime treatment during periods of low flow was the increase in the length of filter runs. Whereas, during the periods of lime treatment, the average filter run was three or four days before backwashing became necessary, upon discontinuation of lime treatment no loss of head was recorded on the filter units after two weeks of continuous operation. The units were backwashed after this length of run merely to rotate the beds and keep them all properly conditioned.

As had been anticipated, three years of constant use have resulted in reduced zeolite unit capacity through physical loss of zeolite and through some deterioration in the exchange value of the old zeolite as compared with the new. From the standpoint of resistance to attrition, however, the service given by the zeolite has been satisfactory, since the actual loss of material has been somewhat less than the guaranteed maximum loss of 3 per cent per year given by the manufacturers. The combination of unexpectedly hard water, the inability to use more than partial lime treatment and the reduced exchange value of the zeolite units has resulted in an actual plant capacity of nearer 75 mgd. than the designed figure of 100 mgd. In order to meet the new conditions, it is planned to increase the exchange capacity of the units by the addition of more zeolite.

#### *Regeneration of Zeolite*

In the early days of plant operation the rock salt delivered at the plant for

regeneration of the zeolite had an average insoluble content well under 1 per cent. Not infrequent deliveries of evaporated salt from seaside sources helped to reduce this average even further so that no difficulty was experienced in obtaining a very clear brine for use in regeneration. With the advent of the war and its attendant transportation problems, deliveries of evaporated salt were halted entirely. As increased demands for salt by war industries taxed the supply, the quality of desert salt depreciated to the point where the average insolubles during long periods ran over 1.5 per cent. Individual cars ran as high as 2 or 3 per cent insolubles. The two salt storage basins at the plant, although adequate to handle easily the required amount of a relatively clean salt, were wholly incapable of efficiently handling a salt with the higher insoluble content. The result of this can readily be visualized. Instead of serving many weeks as a settling basin from which a relatively clear saturated brine could be drawn to pass through the pressure sand filters in the zeolite building and thence to the filtered brine storage to be held ready for use, each of the two salt storage basins functioned efficiently for a period of only about two weeks before it was necessary to take it out of service for cleaning. Not only did this increase the demand for manpower at a time when this situation was already strained, but the brine passing from the salt storage in the last day or two before shutdown for cleaning carried so much insoluble matter to the pressure filters that these proved incapable of completely clarifying the brine. The turbid brine then passed through the filtered brine storage into the zeolite beds. This fine,

almost colloidal clay seemed to seal partially the grains of zeolite so that further reduction in exchange was effected for a few days until all the clay had been washed out. One other situation, involving an undesirable hazard, was brought about by this poor quality salt and the fact that only two salt storage basins were available. If it should happen that both basins required cleaning at the same time, the zeolite units would be forced out of operation due to the lack of clear brine. Fortunately, this has never happened. An additional salt storage basin is now being constructed to prevent any possibility of such an event in the future. When the general commercial demand for salt returns more nearly to normal it is expected that the salt quality will improve accordingly.

Apart from the softening and filtration processes, a problem was occasioned by the great variance in distances of the member cities from the softening plant. It was intended to maintain at least a trace of chlorine residual, as chloramine, at the farthest point in the District distribution system. If chlorination were done only at the softening plant, a relatively high residual might be experienced at a nearby point of consumption, if enough chlorine and ammonium sulfate were added to carry a residual throughout the entire system. This would be particularly true during the periods of low water demand when two weeks might elapse from the time a given portion of the water left the plant until it reached Santa Monica, the farthest distribution point on the upper feeder. To help overcome this difficulty, the main chloramination was done at the softening plant and supplemental chlorination was instituted at Eagle Rod

Orange County Reservoir and Palos Verdes Reservoir. One further problem relative to chlorine residual, created by the great capacity of the pipelines between the softening plant and the member cities, was due to the length of time which elapsed before a change in residual at the plant was noticed at a distant point in the distribution system. For example, in order to maintain a given residual at Eagle Rock at a flow of 25 mgd. a corresponding amount of chlorine and ammonium sulfate must be applied. Should a request for an additional 8 or 10 mgd. suddenly come in, the time required for the water to travel to Eagle Rock is reduced accordingly and the residual at the plant could therefore be reduced. But the pipeline between the plant and Eagle Rock has a capacity of over 80 mil.gal. and, at 30 or 35 mgd., several days would be required for a given portion of water to traverse this distance. For this period, then, if the flow is changed no further, the residual at Eagle Rock might be too high. Conversely, a marked decrease in flow would result in low residuals at the distribution points for a period of time. At higher rates of flow, any change in residual at the plant is felt within a day or two at the nearest point in the distribution system.

The normal processes of softening, filtration and chlorination have been sufficient to meet all requirements of water qualities since the start of operation except on two occasions when it has been necessary to use carbon for taste and odor control. In each instance the use of carbon was continued for just a few days, long enough so that, after the point of take-out at Lake Mathews was changed to an elevation where taste and odor-free water could

be obtained, the system could be cleared of the offending water.

### Experimental Work

Research work is now in progress on several major problems at the softening plant. Tests have been run on a pilot plant scale to determine the best conditions for the regeneration of zeolite sands as changes in their characteristics take place with continued usage. Results to date indicate that, whereas a new zeolite gives maximum exchange when regenerated with a weak brine at a slow rate, after three years of service the zeolite is regenerated better with a stronger brine at a faster rate of regeneration.

In the field of corrosion studies, numerous experiments have been run to determine the efficacy of various substances as corrosion inhibitors. Not only have several commercially distributed products been tried, but a number of hitherto non-commercialized substances were prepared and used experimentally in the corrosion test assemblies set up for the purpose. To date, no practical and economical corrosion inhibitor has been found for District water that will carry entirely through the extensive distribution system. As mentioned earlier, red water complaints are avoided by the maintenance of a relatively high alkalinity and a positive corrosion index, but it is realized that the corrosion problem here, as with many other public water supply systems, is still a major one, and research work in this field is being continued.

Beyond merely reducing the corrosive tendencies of District water, investigations are being made of new softening processes with the view of obtaining a generally improved quality.

Table 2 shows the comparative analyses of finished water obtained from softening of natural Colorado River water by the following processes: (1) full lime-zeolite; (2) partial lime-zeolite; and (3) straight zeolite.

TABLE 2

*Analyses of Treated Colorado River Water*

Constituent	Full Lime- Zeolite ppm.	Partial Lime- Zeolite ppm.	Straight Zeolite ppm.
Silica	6	6	6
Calcium	22	22	25
Magnesium	11	11	9
Sodium and Potassium	217	235	255
Carbonate	11	2	0
Bicarbonate	17	83	138
Sulfate	378	378	378
Chloride	103	103	104
Nitrate	0.4	0.4	0.4
Total Dissolved Solids	757	799	846
Hardness as $\text{CaCO}_3$			
TOTAL	100	100	100
Carbonate	32	70	100
Non-carbonate	68	30	0

*Softening by Electrolysis*

One new process being tried is the electrolytic softening of water. A reduction in anion concentration, as well as in hardness-producing constituents, is effected by the passage of direct current through the water in a specially

designed unit. Not only are the dissolved solids materially reduced in this process, but the dissolved oxygen is reduced from a value approaching saturation to a point where a beneficial effect on the corrosive tendencies of the water from this standpoint may well be anticipated. The investigation is financed by the District and the work is being carried out by R. E. Briggs, inventor of the unit being used for this process, with the co-operation of the softening plant staff.

Data relative to the quality of water obtained through the use of this process and the power requirements for various degrees of softening are not yet ready for publication. Further investigation will be necessary to determine whether the process is practicable for large installations and whether it is economical from both a construction and an operation standpoint.

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## Abstracts of Water Works Literature

**Key:** In the reference to the publication in which the abstracted article appears, **34: 412** (Mar. '42) indicates volume 34, page 412, issue dated March 1942. If the publication is pagged by the issue, **34: 3: 56** (Mar. '42) indicates volume 34, number 3, page 56, issue dated March 1942. Initials following an abstract indicate reproduction, by permission, from periodicals, as follows: *B.H.*—*Bulletin of Hygiene (British)*; *C.A.*—*Chemical Abstracts*; *P.H.E.A.*—*Public Health Engineering Abstracts*; *W.P.R.*—*Water Pollution Research (British)*; *I.M.*—*Institute of Metals (British)*.

### POSTWAR PROBLEMS AND PLANNING

**Financing Through Revenue Bonds.** S. B. ROBINSON. Natl. Inst. of Munic. Law Officers [Rpt. 107 ('44). 55-page pamphlet in 2 parts: (1) general discussion and (2) outline of procedure based on experience of Los Angeles Dept. of Water & Power gained in issuance of over \$235,000,000 revenue obligations comprising some 20 issues more than half of which represent refunding operations. Pamphlet touches on practical problem of business and finance and does not confine itself to strictly legal problems involved. GENERAL: Generally understood that "revenue bonds" payable in whole or in part out of revenues of publicly-owned and self-liquidating util. and reliance placed on adequacy of revenue to make such payments in addn. to all costs of operation, maint. and other charges of util. Usually issued without being secured by any mortgage upon or other hypothecation of phys. properties of util. In some states, however, mortgage required. While in certain cases recourse may be had to taxation, if revenues insufficient for payment, this does not destroy their character as revenue bonds, although detn. of debt-limitation may be affected. Financing through revenue bonds has been practiced over period of some 30 yr. but bonds have only come into their own during last 10 or 12 yr. Strange as it may seem, '29 financial crash one of prime factors in bringing them into prominence. Before depression general obligation bonds regarded as outstanding secure and conservative munic. obligation, with revenue bonds considered as inferior and generally financed on local basis. Even now but few of those states having "legal for savings" statutes have

included revenue bonds in this classification. With this accepted view great surprise to munic. bond fraternity that in stress of depression general obligation bonds in default through non-payment of taxes, while payments on revenue bonds promptly paid from income of going concerns. New York Post Authority and Los Angeles Dept. of Water & Power desired to issue revenue bonds to amts. so large that bonds would have to be issued on natl. basis. Discussion with leading bondhouses lead to realization that most fundamental element in detg. whether particular issue to be considered first class is ability of issuer to meet obligation for principal interest after paying expenses of operation and maint. Likewise, as practical matter, far better to know that util. has sufficient funds to service its debt after operation and maint., than to have recourse to taxing power or to right to foreclosure. Depression years' experience showed high rate of delinquency and mortgage on util. adds little addnl. security. Purchaser of util. at foreclosure will probably have little more success in making it pay than former owner and, if former municipally-owned util., purchaser could not be too hopeful of maintg. good relationships with either public officials or consumers. On other hand, if issue of revenue bonds soundly set up for util. whose service is and will be assured demand, availability of money to meet service charges as nearly automatic as anything can be. In time of depression util. charges paid to avoid interruption of service while taxes go delinquent. Emphasis has swung from consideration of legal remedies in case of default



to consideration of probability of no default through adequate investigation and protection in advance against happening of default by covenants for adequate rates, etc. This changed attitude in last 10 or 12 yr. has resulted in many large life insurance companies and other large institutional investors buying revenue bonds in large quants. Los Angeles Water & Power revenue bonds now carry Moody "AA" rating. \$15,000,000 issue of these refunding electric-plant revenue bonds of '44, maturing in '45 to '76 with avg. life of 19 yr., sold in Feb. '44 at net interest cost of 1.7755%. Must of course be underlying statutory authority for issuance of revenue bonds. PWA and WPA suggested adoption by various states of legislation on this subject. Believed that such authorization exists in over half the states. While not fundamental in same sense as basic authority, desirable and sometimes necessary that there be adequate statutory provisions covering certain features of procedure of issuance of bond form, etc. Likewise, util. must be able to show that it is on sound business basis. Constitutions of most states probably contain limitations on amt. of indebtedness which may be incurred. Sometimes unqualified limitation; in others limitation may be exceeded by voters. Such limitations usually held to apply only to indebtedness which may result in taxation. Accordingly, indebtedness payable solely from util. revenue or other "non-tax" source generally held outside of such limitation. However, some confusion as to extent of such exemption. Greater number of decisions hold that indebtedness not within such constitutional limitation if paid solely out of revenue of util. without distinction as to whether such revenue arises from util. newly acquired or constructed by such indebtedness or from addn. to util. already constructed. Lesser number of decisions hold that indebtedness for addn. does not escape such limitation unless payable solely from revenues of such addn. Those interested in this distinction referred to briefs in case before Supreme Court of California (218 Cal. 206, 22 Pac. [2d] 698, Case S.F. 14899) which analyzed all relevant cases prior to '33. Question of whether approval by voters should be required debatable. In favor is fear that authority will pile up unjustified indebtedness. This has some automatic check in that no syndicate of bankers will buy issue under such condition. Against require-

ment fact that special election expensive, waiting for general election involves delay (in some cases bond issues can only be voted upon at general election), necessary campaign for bond issue expensive, active minorities opposing issue may result in its defeat although not reflecting true attitude of majority of citizens. Foregoing applies to "new money" bonds. Unanimity of opinion that refunding bonds creating no new indebtedness should not require such vote. In this case, time important and this cannot be met by vote of people. If it be deemed as matter of policy to require popular vote, following should be exempted: (1) refunding bonds, (2) bonds required by emergencies, (3) limited amt. each yr. based on avg. annual cost of addns. and betterments. Desirable that revenue bonds be issued as negotiable instruments. Revenue bond, being promise to pay out of particular fund, clearly not *unconditional* promise to pay and, therefore, unless Uniform Negotiable Instruments Act has been supplemented by legislation making revenue bonds negotiable, they must be regarded as non-negotiable. Legislation to permit issuance of revenue bonds should make provisions for declaring them negotiable instruments. To avoid difficulty regarding negotiability, wise to avoid any language implying that bonds to be "payable" outside of state which issuer operates but to provide that such bonds shall be "collectible" in some specified city. Competitive bidding vs. private negotiation much debated. If not settled by statutory provisions matter of policy. Points pro and con: competition results in higher prices paid for bonds; investment bankers to be regarded as counselors and continuing relation should exist between issuer and banker; advice of banker of value to issuer and he cannot be expected to spend much time and expense in setting up plan if subject to chance of competitive bidding; banking house cannot safely offer as high a price on competitive bidding as on negotiated sale, since if successful bidder has purchased issue on 2% basis while another banking house of recognized standing has put in bid on 2.25% basis, successful bidder will have difficulty in reselling bonds because 2.25% bid is expression of opinion of highly regarded firm that bonds not worth price at which successful bidder must offer them; public officials should not take responsibility to exclude competition; well-established util.

that has marketed numerous issues of bonds and whose bonds have become "seasoned," can proceed on basis of competitive sale; util. making its first offering or util. of unusual character cannot know that any particular plan will meet approval of bond houses and cannot be assured that bids will be received. Therefore, may be highly desirable for this util. to develop plan under private negotiation. Policy of Los Angeles Dept. of Water & Power has been that of competitive bidding. While recent decisions tend toward requiring clear and unmistakable authority for original creation of bonded indebtedness, they tend toward recognizing implied authority to refund indebtedness evidenced by revenue bonds. Desirable legislation should authorize issuance of refunding bonds well in advance of call date of bonds to be refunded. Author understands that New York State permits issuance of bonds 1 yr. in advance of call date. This permits taking advantage of bond market and duplicate interest charges can be offset by investment in govt. or other high-grade bonds. Legislation should also authorize refunding bonds not only for face value of bonds to be refunded, but in amt. necessary to provide for payment of any premium which must be paid on redemption of bonds to be refunded. Highly desirable that bonds be "legal for savings." Few states have adopted "legal for savings" laws for revenue bonds in general. July, Aug. and Christmas season should be avoided. Issuer of large issue should become informed of large offerings by federal govt. or others and avoid risks of interference with resales. Successive issues by same issuer should not be offered at short intervals. PROCEDURE: Procedure set forth based almost entirely upon that worked out by Los Angeles Dept. of Water & Power and is offered as aid to others. Fully realized, however, that procedure must be adopted to fit existing statutory requirements and particular issue offered. In placing some 20 issues, no 2 followed same procedure exactly. Investing public seems more used to buying munic. water bonds than munic. elec. bonds, consequently, simplified procedure suffices for water bonds. The newer and more unusual the util., the more complete must be the procedure. Procedure typical for issue of elec. bonds to be sold by competitive bidding. This may be simplified in case of well-established water works. *Preliminary Steps and Direct Contacts.* One of first ques-

tions to be detd. is bond market to be reached by offering. This controlled largely by locality of util., size of issue and in case issuer has offered previous issues, market in which bonds have become "seasoned." Difficult to state limiting size of bond issues that should be offered on local, regional or natl. basis, as various elements enter into ability of given market to absorb given issue. Any issue approaching \$20,000,000 should be offered only in New York or some other financial center with facilities for natl. distr. Definitely recommended that where bonds to be sold on regional or natl. basis, representative of issuer proceed to selected financial center in advance of any formal action by issuer and spend all time necessary in close contact with bond counsel and representatives of bond houses likely to be interested in purchase of issue, for purpose of developing and detg. most advantageous terms for issue. For first issue, whole financial plan must be developed. For subsequent issues, there will be fewer problems. This personal contact of value in that it enables banker to know personally those in charge of util. This personal contact of responsible heads of util. and bankers allows for intelligent and adequate recommendations for final setup of offering. *Formal Action:* Successive steps in formal action looking toward issuance of bonds may be summarized as follows: (a) *Preliminary Resolution*—Authorizing publication of notice for receipt of proposals; fixing general terms and conditions on which bids will be received; providing that certain documents will be available to bidders and authorizing receiving and opening of proposals at stated time and place. (b) *Notice*—Publication of notice inviting proposals. When bonds to be offered on regional or natl. basis publication should usually include paper in selected financial center. (c) *Official Statement and Bidding Paper*—Bidders should be furnished with copy of prelim. resolution, notice, forms for bidding and "Red Herring" Official Statement, which carries on each page diagonal red imprint stating that it is advance copy of proposed statement and that its use in connection with sale (or resale) of securities not authorized. Statement should include description of util. and various eng., financial, legal and miscellaneous information and proposed form of final resolution authorizing issuance of bonds. (d) *Receipt of Proposals and Acceptance of Best Proposal*—Resolution

accepting best regular proposal should include rejection of all other proposals. (e) *Final Resolution and Official Statement*—Adoption of final resolution and prepn. of official statement based upon accepted proposal. Various miscellaneous steps such as notice of and acceptance of proposal, return of certified checks, authorizing printing of temporary bonds and engraving of definitive bonds and such other procedure as may be required to be taken in advance of closing. (f) *Closing*—Transcript of all proceedings must be prepd., certified and delivered to bond counsel sufficiently in advance of closing date to permit its examn. by them and prepn. of their approving opinion for delivery upon closing. Bond counsel also customarily requires signature certificate, certificate that no litigation pending affecting validity of bonds or that there has been no legislation affecting validity of bonds since last available published laws. At time of closing receipt of issuer required showing that proceeds of bonds received. About 2 wk. after opening of proposals temporary bonds and approving opinions delivered and amt. due issuer paid. (g) *Definitive Bonds*—These, when engraved, exchanged for temporary bonds. Prelim. resolution, notice and bidding form interrelated and of prime importance because they set up framework of issue. Resolution should recite purpose and necessity of issue, authorization to receive proposal and publication of notice thereof, statement of amt. of issue and interest payment dates and provide for following: (a) interest rates as in accepted proposal; (b) maturities and redemption as specified in proposed final resolution; (c) bonds to have specified date, payable from certain revenues, be in coupon form, usually of \$1000 each, be substantially in accordance with appended form, and be registerable as to principal or as to both principal and interest; (d) proposal must be for not less than par, for entire issue and may specify not to exceed (usually 3) interest rates in multiples of 0.25% and may contain statement as to max. net interest rate which will be considered; (e) interest rates named by bidder shall not result in violation in any statutory limitation on permissible variation of annual charge; (f) proposal must be accepted within time stated and may be by telegraph; (g) proposals to be on basis of delivery of temporary bonds at specified place usually about 10 days after receipt of bids; (h) proposals unconditional,

except that they may be conditioned upon furnishing of several thousand copies of official statement, adoption of final resolution, furnishing of opinions of bond counsel as to validity of issue and exemption of interest from taxation and that, prior to delivery of temporary bonds, income has not been declared taxable by decision of federal authorities; (i) proposals received at stated time and place accompanied by certified check usually amounting to 2% of issue and provide for its application onto purchase price, forfeiture in case of default or return to unsuccessful bidder; (j) proposals to be on form provided with copy of official statement attached; (k) lowest interest cost need not govern award and right reserved to reject any and all proposals; (l) resolution intended to indicate general terms and conditions of sale but not limitation on power to receive, reject or accept proposals and anything inconsistent with final resolution deemed amended accordingly. Final resolution and bonds themselves constitute entire contract between issuer and bondholders. Therefore, resolution authorizing invitation of proposals should not be incorporated in official statement. Resolution, in addn. to above, should contain routine provision relative to printing and distr. of resolution, notice, bidding form and "Red Herring" copies of official statement, and, if proposals opened at other than home city, authorization for representative of issuer to act at opening. Published notice and proposal blanks should fully reflect principal features and terms of resolution. *Official Statement*—Document comparable to prospectus issued in offering corporate bonds, in quite general use. It should be issued in 2 editions; first in "Red Herring" form to furnish information to prospective bidders and to provide for proposal to be complete by having statement referred to and attached to proposal and final edition with figures in accordance with proposal and award. Principle of full disclosure underlies prepn. of statement and author believes it is good policy to be ultra-conservative in detg. what should be included. Statements should be strictly factual. Facts of adverse or unfavorable nature should be frankly disclosed. Following summary may be regarded as typical of what appropriately may be included: (a) amount and purpose of issue; (b) organization of issuer and principal officers; (c) brief statement of nature and

extent of business; (d) statement of outstanding bonded indebtedness of issuer payable out of same revenues as proposed issue and, if such be the case, that incurring of addnl. indebtedness payable out of same revenue limited by statute; (e) statement of income and expense before and after depreciation which may include statement of facts showing that proposed issue within debt limitation imposed by statute or otherwise; (f) rate schedule of charges for service rendered by util. with comment as to outside control and policy of issuer; (g) description of system; (h) summary of major provisions of basic supply contract if util. obtains substantial supply of its commodity by contract from another; (i) statement of retirement plan for personnel; (j) depreciation plan; (k) insurance policy; (l) statement of special circumstances affecting issuer at time of offering bonds; (m) statement as to extent revenues have been or may be diverted from specific use of util.; (n) statement of outstanding non-routine contracts; (o) statement as to liability of certain property of issuer to taxation; (p) statement as to pending or threatened litigation; (q) statutory authority to issue bonds; (r) opinion of bond counsel and attorney of issuer that bonds tax-exempt; (s) statement as to legality for savings; (t) legal opinion approving issue; (u) statement that all statements made on best information citing source and believed to be reliable and correct but no representation made that they are correct or will be realized, that agreements of issuer with bondholders fully set forth in final resolution. Statement should be signed in name of issuer by its president or other appropriate official and be accompanied by historical financial statements, report of certified accountant, report of engr., final resolution and excerpts from statutory provisions under which the bonds issued. *Final Resolution*—In all cases there must be definite official action of controlling authority authorizing each issue of bonds and fixing terms and conditions thereof. May be in series of resolutions or ordinances but author suggests that entire authorization be incorporated in one final resolution which will supersede all prior resolutions, leaving final resolution and bonds themselves to contain all terms and conditions of issue. Principal features of this resolution summarized as follows: (a) Recital of facts showing necessity of issue. (b) Creation of issue of bonds stating

formal designation, purpose for which issued that terms and conditions shall contract, that all acts, conditions and other requirements have been carried out as required by statute. (c) General description—(1) Statement of routine matters of bond designation, date, payable in any coin or currency of U.S. which, at time of payment, legal tender for public and private debts. Statements that bonds payable solely out of certain designated funds. \* (Language used to express nature of charge against fund should be given careful consideration. In opinion of author objectionable to make bonds "lien" on revenues or to "pledge" revenues for payment of bonds. "Pledge" implies delivery while "lien" ordinarily connotes right of creditor to reduce to possession thing upon which he has lien. Both concepts go beyond what is appropriate in case of issue of revenue bonds where all that would seem necessary is segregation of revenues and promise to pay out of that segregated fund.) Statement that bonds shall be issued in negotiable form, statement of place of payment. (2) Statement of amt. of issue, interest payable semi-annually on designated dates and dates on which bonds shall mature and be payable. (3) Statement that bonds and coupons to be printed from steel engraved plates and substantially in form annexed to resolution. (4) Statement as to how bonds and coupons to be signed in behalf of the issuer and provide that if any signer ceases to hold office before delivery of bonds, signature shall be held valid. (5) Routine statement on denominations and numbering. (6) Provision for registration. (7) Provision for lost and destroyed bonds. (8) Provision for temporary bonds. (d) Section establishing reserve fund to insure payment of principal and interest when due and providing that premium and accrued interest at time of sale shall be deposited in said reserve, bearing in mind that procedure in setting up reserve fund depends upon statutory provisions. (e) Amortization of entire issue by payments in accordance with schedule set up in resolution. (If serial bonds issued maturities may be made on basis of "flat principal payment" or "flat service charge" plan. Flat service charge plan seems definitely desirable in case of growing util. If term bonds to be issued addnl. amortization data setting forth that principal to be paid each yr., notwithstanding fact that on face of bond all payable at fixed date, shall be in accordance



with amortization table.) Provision that retirement of bonds shall be effected by payment of serial bonds and in case of term bonds by acquisition and cancellation by issuer, by redemption as hereinafter provided or by payment at maturity, provision that obligation to retire bonds in advance of maturity of term bonds may be waived by consent of holders of 60% of issue. (f) Article relative to redemption of bonds should set forth right of redemption and redemption price, form of notice of redemption, effect of redemption and availability of money, and provide for cancellation of redeemed bonds. (g) Article setting forth various covenants made by issuer. These covenants of major importance as they are to be regarded as substitute for recourse which holder of general obligation bond has to the right to enforce exercising of taxing power for his protection or right which holder of mortgage bond has to require foreclosure of mortgage. Preamble should provide that until all bonds have been paid or money has been placed in reserve fund sufficient to retire all bonds issuer covenants with bondholders as to (i) rates to be established and charges collected to be sufficient to pay out of revenue principal and interest charges in addition to all other obligations; (ii) no subsequent indebtedness shall have priority of payment of charges for this issue; (iii) util. shall not be sold unless such sale shall provide for continuance of payments into some fund for principal and interest charges; (iv) limit shall be placed on transfer of util. funds to general funds; (v) limit shall be placed on incurring of future indebtedness payable out of util. revenue; (vi) provide for independent audits of books; (vii) provide that all covenants contained in article and all terms and conditions of bonds as set forth in resolution irrevocable and not subject to change or alteration except as expressly provided in resolution and that any bondholder shall have right to enforce by appropriate proceedings in any court of competent jurisdiction provisions of bonds and resolution.—O. R. Elting.

**Report on the Development of Adequate Water Supplies for North and South Jersey.** N.J. State Water Policy Com. (Feb. '45). Economical and comprehensive development of all water resources in principal watersheds of state necessary now because: (1) *North Jersey* (Northeastern indus. counties). Supply systems carrying unprecedented load.

Resources being strained to meet demands. Emergency measures will not suffice if consumption pursues its upward trend and, (2) *South Jersey*. Surface and underground supplies need comprehensive development to overcome poln., prevent salt-water intrusion, meet indus. and seashore development, provide irrigation and forest fire protection. Com. recommends as declared water policy: (1) North Jersey project capable of yielding 25 mgd. in its initial step, 75 mgd. in its intermediate step and 145 mgd. at full development. To effect this, advised that: (a) Site at Dock Watch Hollow, in Somerset Co., be acquired for high-level supply reservoir. (b) Site known as Round Valley, in Hunterdon Co., be acquired for intermediate level supply if, and when, Dock Watch Hollow supply approaches max. use. This site can be developed in future when necessary. Two supplies can then be co-ordinated. (2) South Jersey project looking to acquisition of sites on several watersheds in southern counties for conservation of ground water resources of shore resorts and indus. areas and for irrigation, fire protection and recreation generally, by storage of flood waters. To effectuate this policy, implementing legislation necessary providing that: (1) Plan outlined in this report be adopted by Legislature as basis for developing addnl. water supplies for several areas of state. (2) *Flood flows* from headwaters of Raritan R., including North and South Branches, and that *flood flows* from Musconetcong R., be set aside and dedicated, by appropriate legislative action, for potable and public water supply use to be developed when and as needed. (3) Constr. begin as soon as conditions permit, so that safe, adequate and economical water supply can be assured. (4) State Water Policy Com. be directed to prepare necessary plans and ests. of costs for constructing each project and for acquiring necessary land. (5) Laws governing State Water Policy Com. be amended to give com. authority to purchase land necessary to aforesaid plans. (6) Legislation include limitations and restrictions as follows: (a) *Lake Region*. To specify that under no circumstances shall Lake Hopatcong, Lake Musconetcong or Budd Lake be drawn down to add to supply of potable water. Intakes for water supply be far enough away from lakes to preclude san. restrictions on their use for recreation. (b) *Sale of Water*. To

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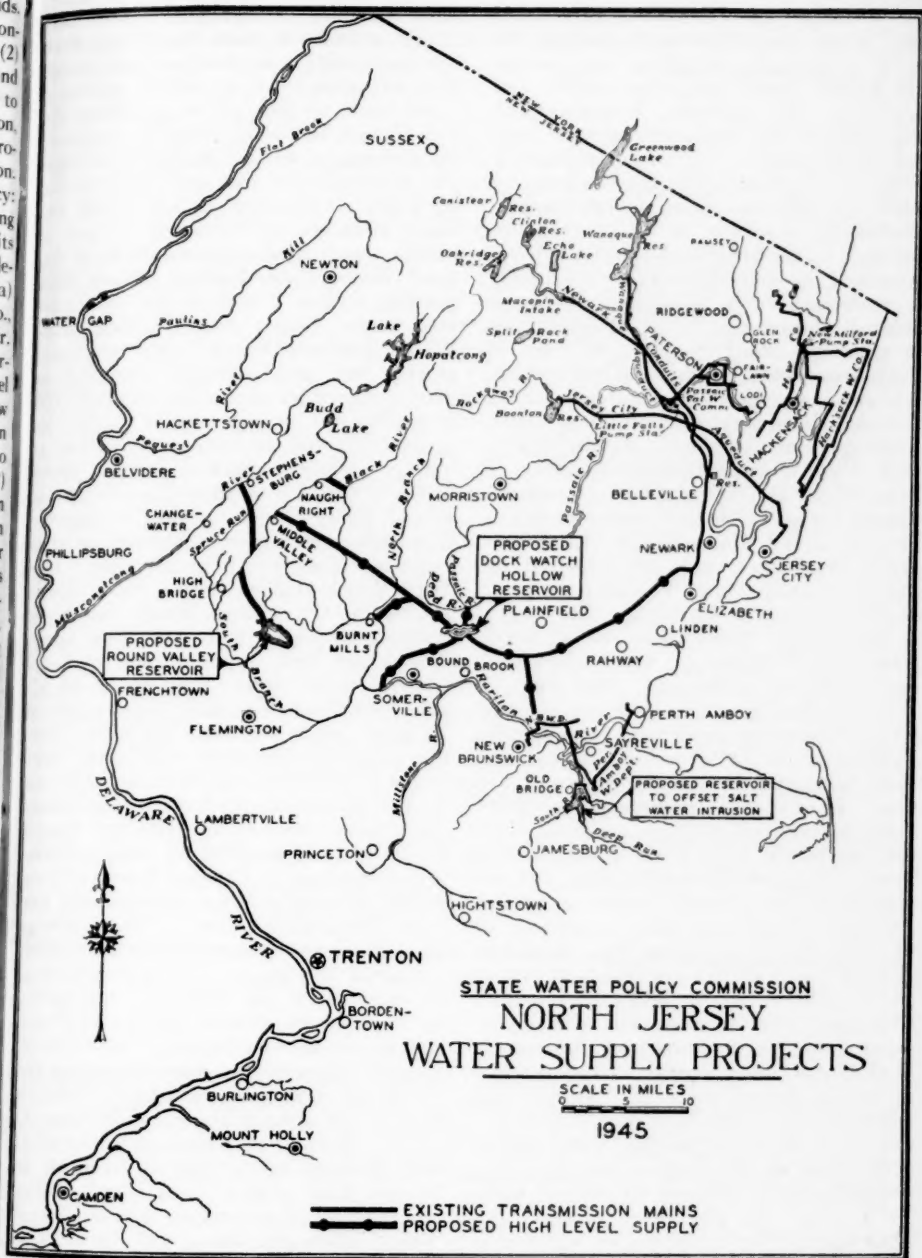


FIG. 1

provide that water impounded shall not be sold in competition with existing water agencies. Water should be made available directly to those municipalities, commissions and private water companies owning and operating distr. systems. Formulas and prices matters for agreement between state and those agencies. (c) *Taxes on Reservoir Property.* To provide that taxes on property taken for reservoirs, pipes or other appurtenances be based on '44 valuations unless and until valuations generally higher or lower because of changed conditions in municipality or municipalities in which such property situated. Legislation should prohibit taxes on structures added by state. In event of disagreement between state and municipality as to proper assessment of valuation for taxing purposes, either party should have authority of taking question to courts. **NORTH JERSEY: Dock Watch Hollow.** Plan for utilization of Dock Watch Hollow outgrowth of personal observation of workings of water intakes in New York and Massachusetts, which suggested that water could be conveyed by gravity to Dock Watch Hollow from point on South Branch of Raritan R. Chief engrs. of State Water Policy Com. and of North Jersey Dist. Water Supply Com. have stated that operation feasible one. (See Fig. 1.) According to engrs., excess waters of river may be taken into catch basin near Middle Valley at el. of 500' or more. Thence they could be carried by tunnel distance of less than 5 mi. and thence transmitted by diversion pipelines another 12 mi. to reservoir with flow line of 460' el. at Dock Watch Hollow. Two chief engrs. est. that building dam for reservoir, collecting pipelines and tunnel and system of transmission lines to territory to be served would take about 5 yr. Reservoir at Dock Watch Hollow would be built to hold 15 bil.gal. of water and yield daily supply of 75 mil.gal. when supplemented by pumping water from North Branch of Raritan R. Dock Watch Hollow location studied by engrs. at various periods since '29. At one time considered for reservoir as part of Delaware and Raritan Canal potable water supply project but as that project was planned it would have been necessary to pump all water to it. For this and other reasons, idea abandoned. Method of getting water to it now contemplated will supply major part of water without pumping. Dock Watch Hollow can be made ready for use in years of

reconversion just after close of war. Emergency pumping arrangements would make 25 mgd. available in about 3 yr., during which time dam could be completed and land cleared. No equalization reservoir would be necessary. Water could be delivered to connecting link with Newark high-level system at corresponding pressure, as well as distributed to Union and Middlesex Counties and lower Raritan R. Valley. Utilization of both North and South Branches of Raritan R. as part of potable supply would preclude constr. of ship canal reservoir on Raritan. Burnt Mills pumping station, if built, would be in reservoir basin. Engrs. estimate that Dock Watch Hollow Project, with permanent gravity feed and temporary pumping, as herein outlined, would cost around \$25,000,000 to \$30,000,000 for capac. of 75 mgd. This project proposed for commencement just as quickly as war conditions permit. **Round Valley Project—Hunterdon Co.** Constr. of Round Valley Project matter for future—time for its commencement should depend on business outlook 5 or 10 yr. after war. Like Dock Watch Hollow, Round Valley site in Hunterdon Co. almost ideally suited for reservoir purposes. Hills form deep, horse-shoe-shaped bowl, requiring bldg. of but 2 relatively short dams. Estd. capac. 42 bil.gal., from which dependable water supply of 70 mgd. could be made available. Area that would be taken about 3100 acres. Flow line at Round Valley would be 370' above sea level—ample to supply Somerset, Middlesex and Union counties by gravity. Project herein outlined superior to those contemplated years ago at Chimney Rock and Long Valley (Bunnvale). Two storage sites now under consideration have combined acreage to be converted to water supply use of 4600, compared with greater areas of 6600 acres at Chimney Rock and 7200 at Long Valley. In Dock Watch Hollow and Round Valley sites no extensive settlements to be destroyed. Valleys cultivated but farm properties not numerous. Combined storage of Dock Watch Hollow and Round Valley would equal 57 bil.gal. Storage at Chimney Rock would have been 45 bil.gal. and at Bunnvale 46 bil.gal. Estd. yield of Dock Watch Hollow when completed with gravity line, plus Round Valley, when completed with its links to take flood flows of Musconetcong and Black rivers, placed at 145 mgd. Yield of Chimney Rock placed at 145 mgd. and of Bunnvale



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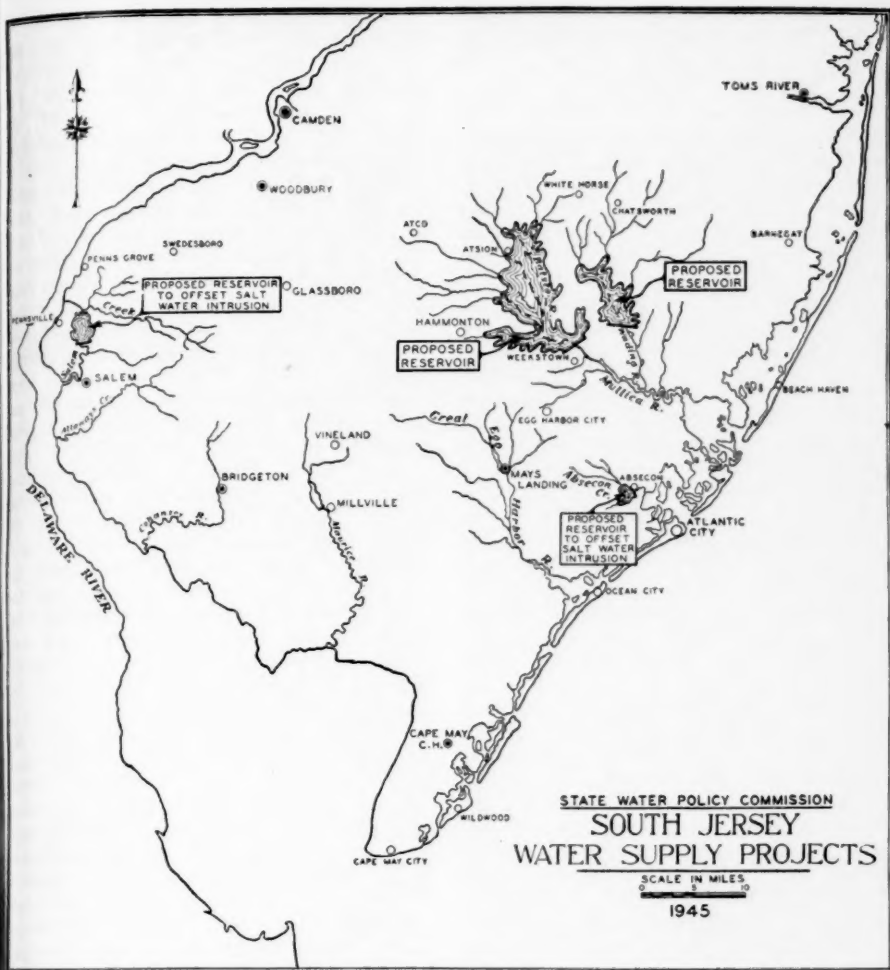


FIG. 2

at 152 mgd. SOUTH JERSEY: Southern counties get their potable water mostly from wells. Underground waters adequate for time being but surface storage at present provided, here and there, negligible and no telling when supply will give out. Floods in recent years have put several out of operation for short periods. Shifts in supplies have been compelled by poln. and by depletion of wells. Hurricane of Sept. 14, '44, caused temporary poln. of several deep wells near coastline.

Consumption of water in South Jersey counties now 15.62 mgd. more than in '33, increase of 33% in 10 yr. Several rivers in South Jersey with abundant flow in flood seasons which could be impounded without unwarranted cost. Great Egg Harbor R. at Mays Landing has 216 sq.mi. of watershed. Batsto R. has drainage area of 70 sq.mi. Mullica and Wading rivers, above tidewater, have about 412 sq.mi. Impounding waters of any of these streams would not be difficult. Each

could afford generous supply of good potable water. Mullica-Wading rivers could be impounded up to 106 bil.gal., yielding over 300 mgd. Such quant. far beyond likely requirement of potable water but it could be utilized as effective fire break and source of emergency water to long coastal stretch, while at same time serving wide inland area. (Fig. 2.) Atlantic City area, where wells in 100' horizon have drawn in salt water, proposed to build surface water reservoir on Absecon Creek and flood salt marshes with fresh water to raise ground water level and push back salt water. This would restore to use wells now abandoned and assure their future usefulness, as well as increase yield of 100' horizon. Along Delaware R. below Camden large supplies of water for public and indus. use taken from wells. Draft has increased greatly and ground water has been permanently lowered. Salt-water intrusion has occurred in 2 indus. well fields. Existing reservoir on Salem Creek has helped situation, but more protective measures should be taken. Other fresh water reservoirs in this area, especially on Lower Salem Creek, should be built. Similar project suggested for Sayreville area, in eastern Middlesex Co., where wells in so-called Farrington sand have drawn in salt water. Fresh water reservoir on Deep Run and South R. below Old Bridge would keep out tide water from Raritan Bay and flood salt marshes with fresh water, thus protecting wells in that highly developed area from contam., and increasing yield. North Jersey area depends too largely on wells and river intakes without storage for its supply of potable water. Water stored for dry weather requirements inadequate. Comparison with New York and Massachusetts water supplies illustrates that truth.

#### Storage Capacity of Main Reservoirs

	mil.gal.
Northern New Jersey.....	53,300
Metropolitan Boston.....	415,000
New York City (after Delaware project completion).....	480,000

These are thickly populated, heavily industrialized—comparative and competitive—business sections of U.S. Boston section, with fewer people and industries, has 8 times as much stored water as Northern New Jersey; New York City, with  $2\frac{1}{2}$  times as many people, has  $9\frac{1}{2}$  times as much water storage.—Ed.

**Water Engineering After the War.** N. A. F. ROWNTREE. Wtr. & Wtr. Eng. (Br.) 46: 451 (Nov. '43); Jour. A.W.W.A. 36: 12 ('44). *Editorial Notes.* Wtr. & Wtr. Eng. (Br.) 47: 7 (Jan. '44). *Discussion.* *Ibid.* 47: 48 (Feb. '44). N. G. ELLIOTT: One quarter of water authorities in country supply pop. of less than 5000 and small undertakings supplying 2000 to 3000 must be amalgamated. One of chief problems would be financing of supplies to rural dists. Loan periods granted by Ministry of Health considerably shorter than life of assets. Cost of fuel, wages and repairs in pumping station could be deducted from income tax but loan charges on large storage reservoir cannot. If rate of interest kept down, loan periods extended and loan charges deducted from income tax, stimulus to capital might be greater than introduction of govt. grants. G. G. BARRETT: Major problems likely to affect profession after war would be due to changed living conditions arising directly from internatl. agreement and natl. legislation. Inst. members could offer invaluable advice to those responsible for framing new legislation. In discussing education, speaker suggested that younger men might apply their more recent scientific training to research. J. F. HASELDINE: Do not agree with suggestion that smaller replicas of Metropolitan Water Board should be set up in provinces. Problem should be divided into "distribution" and "resources." Distr. largely parochial matter and being satisfactorily carried out, but some form of grouping of resources might be improvement. A. A. WOOD: Pessimistic regarding prospects of maintg. public co-operation after war when public would be anxious to throw off restrictions. There would undoubtedly be widespread reaction against bathing in max. of 5' of water. Already there appears to be a falling off in public co-operation for reducing waste. DELWYN G. DAVIES: To avoid misfits in personnel of postwar water eng., extension of methods of selection of recruits beyond usual exams. should be considered. Raising of std. of water engr. desired by all even though they already produce least toxic water of any country in world. Up to present university graduate had to weigh in balance delight in performance of work against prospective income. Speaker suggests, therefore, that Com. of Postwar Reconstruction examine economic status of water engr. and draw new code of practice relating to conditions of

employment. S. D. CANVIN: Judging from experience of both wars civilian life might quite possibly be much the same again as far as water requirements concerned. Might be good to imagine conditions in future: (1) Lack of technical assistants, as so few young men now completing course in civ. eng. (2) Eng. assistants might not be demobilized early. (3) Younger men might be called up under Conscription Acts. (4) Eng. materials and factories would not be under full production on peacetime scale. Major planning in future might be disappointing. Having been forced to pursue for years major plan of destruction in war, price yet remains to be met. P. G. H. BOSWELL: Framing and pursuance of natl. water policy long overdue. In meantime, desirable that development of underground water resources be controlled. After war competition for water would be intensified. In matter of rural supplies every local underground supply should be exploited before relatively heavy expenditure of main laying and reservoir building contemplated. Now one is led to believe that every boy intellectually fitted is able to go to university to take first degree. If it were desired to supplement this by more specialized study, indus. firms or other bodies could establish funds to enable selected students to stay at university for addnl. year. CLAUDE PAIN: To show how water industry at present divided between thousand or so authorities, appears to need prepn. of map. Such map has been prepd. covering Southern Civil Defense Region. Water industry surely by now of sufficient primary importance to be separated from Ministry. C. A. RISBRIDGER: Suggested that coms. considering reorganization conform with democratic way of life to which we are committed and be evolutionary in character, not revolutionary. Suggested that for present, at least, central govt. should limit control to that which may be exercised through new act so framed as to standardize best modern practice. Questions arise as to why it is desirable to take control from companies which have met their obligations to public in full. Reasons are that supply of water should not be undertaken for private gain and water works practice might be more easily standardized if all undertakings administered by bodies of similar constitution. *Author's Closure:* Formation of com. to consider eng. aspects of water supply after war greatly to be welcomed. Would be

disappointing if com. should fail to study admin. methods. If com. would exam. more general and less technical aspects of water supply, their report would be greatly strengthened by study of basic data.—H. E. Babbitt.

**The Water Bill.** *Editorial.* Wtr. & Wtr. Eng. (Br.) 48: 106 (Mar. '45). Water Bill, 1945, from which so much expected, introduced into House of Commons on Feb. 2. Object of bill is to enable effect to be given in England and Wales to policy set out in Part I of White Paper presented to Parliament in Apr. '44—to make possible natl. water policy which will secure that "all reasonable needs for water by householders, industry and agric. can in future be met speedily and without avoidable waste." For first time, govt. will be directly responsible for water supply. In words of Water Bill, it "places for first time on Minister of Health specific duty of promoting in England and Wales provision of adequate water supplies, conservation of water resources and effective execution by water undertakers, under his control and direction, of natl. water policy." Bill divided into 5 parts. Part I gives statutory powers to Ministry of Health and provision made for Central Advisory Water Com. and for local Joint Advisory Water Coms. (constituted by order of Minister where necessary, and which would have duty of planning ahead to meet future needs of their areas). Dept. of Scientific and Indus. Research given power to obtain information as to strata from persons sinking wells or boreholes. Part II deals with local organization of water supplies and includes mch. for securing, if necessary by compulsion, combination of undertakers and transfer of undertakings. Variation of limits of supply and supply of water in bulk. Part III provides for conservation and protection of water resources and prevention of waste. Under Clause 14 Minister may make order defining area where special measures necessary for conservation of water in public interest and in such area, except for supply for purely domestic uses, well or borehole can only be sunk under license from Minister. This part makes it offense to allow underground water to run to waste, or to abstract it in excess of reasonable requirements; water undertakers empowered to make agreements with owners, occupiers and local authorities for carrying out drainage and other works intended to



safeguard purity of supplies; to limit use of hose pipes in periods of drought; and to execute works for the protection of sources. Also gives powers to water undertakers to make bylaws, subject to confirmation by Minister, for preventing waste, misuse, contamination and pollution of water. Pollution of any spring, well, etc., from which water used for human consumption made subject to penalties. Part IV enables or provides machinery for enabling statutory water undertakers to construct works, to purchase land, to obtain and supply water and to deal with various other matters essential or incidental to carrying on their undertakings. Provision made for compulsory acquisition of land and of water rights. Water undertakers required in certain circumstances to supply water for industrial, agricultural and other non-domestic uses. Various other powers and duties of local authorities and other statutory water undertakers laid down. Wherever practicable and reasonable, piped supply of water to be brought into house. Bill to be operated by simplified system of ministerial orders. Interested

parties would have full opportunity to put their views before Minister. Orders for compulsory amalgamation of undertakings, compulsory taking of water rights and certain other matters would be subject to review by Parliament if opposition maintained after local inquiry. As Bill stands, review by Parliament will be by means of Provisional Orders. If legislation passed setting up special procedure to take place of Provisional Orders, intended that that procedure should apply to Provisional Orders under this bill. Part V deals with various matters of machinery, including inquiries, regulations, prosecutions, penalties, expenses, notices, entry of premises, definitions (Clause 57), savings and repeals. Finally, Bill consolidates and modernizes "Waterworks Code" on lines of Water Undertakings Bill of '43 (3rd schedule) and prescribes uniform procedure for revision of water rates and charges (Clause 38). [Note: For a complete outline of government's proposals see Harry B. Shaw's article, "A Review of Current British Thinking on Water Supply," in the Jan. '45 issue of the JOURNAL.]—Ed.

## CROSS-CONNECTIONS AND PLUMBING

**Elimination of Cross-Connections in Los Angeles, Calif.** HARRY HAYES. Proc. A.S. C.E. 71: 271 (Mar. '45). City of Los Angeles has undertaken one of most carefully planned programs for control and elimination of cross-connections of any city in U.S. "By term 'cross-connection' is meant any connection between any part of water system used or intended to supply water for drinking purposes, and any other source or kind of water that is not or cannot be approved as reasonably safe and potable for human consumption whereby water from unapproved source may be forced or drawn into drinking water system." Right of entry to private property to investigate water use established by rules of Bd. of Water & Power Comrs. which have all force and effect of general laws. In '42 Cross-Connection Control Advisory Com. founded to take over cross-connection control and eliminate from entire city. Committee invested with police powers in so far as they pertain to cross-connection control. Inspections of water piping systems undertaken by committee's inspection force. Early in '42, series of incidents showed that pollution getting into mains in Los Angeles harbor area. In one incident ship's officer on ship tied to

wharf connected fresh-water system in yard to salt-water system on ship, started ship's pumps, and pumped sewage-polluted salt water throughout yard's drinking water system. Such occurrences have not been confined to plants in Los Angeles or Calif. In Aug. '42 7-point program adopted: (1) *Protection at Meter*. Requirement of backflow protection at meter not confined to harbor-front properties, but to any property having access to auxiliary water supplies and pressure-producing equip. for utilizing such supplies. Fundamental principle of backflow protection is air-gap or broken connection. In general least air-gap resistance required is twice diam. of inlet pipe. Where impossible to require use of foregoing methods of protection on water service, committee allows use of backflow protection devices of approved types. Such approved devices shown in Figs. 1 and 2. Great progress made in development and design of modern backflow protection devices. Latest development is device incorporating zone of reduced pressure in line of flow through device. (2) *Protection at Wharf*. All pierhead outlets, on wharves, for supplying fresh water to ships must be protected against backflow. In every case this

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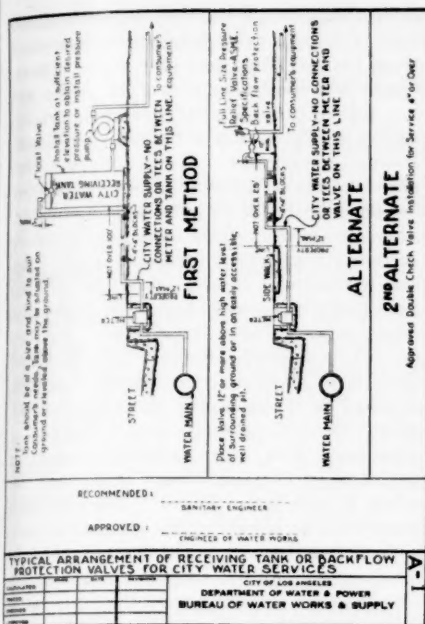


FIG. 1

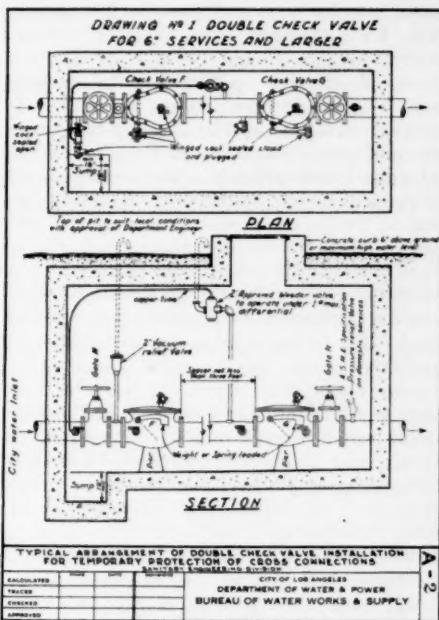


FIG. 2

means that protective device must be installed on each outlet. (3) *Pollution Through Fire Lines.* Domestic water lines and fire-protection lines must be separated where there are auxiliary pumps or intakes, or cross-connections to pold. secondary water supply. (4) *Plumbing Cross-Connections.* Requirements that all plumbing cross-connections must be elimd. covered by plumbing ordinances and include such specifications as low inlets to tanks and basins, toilet flush valves without vacuum breakers, etc. (5) *Pollution Through Processing Water.* In ordinary times when material is available committee would require separate system for carrying all indus. or processing water. (6) *Color Warnings.* Wherever there are two water systems in plant committee requires that both systems be painted in distinctive colors. (7) *Proctorship Supervision.* Organization of water foremen for each premise to supervise unified plan of water protection started early in program.—H. E. Babbitt.

**New Plumbing Standards to Keep Drinking Water Pure.** A. A. KALINSKE & F. M. DAWSON. Indus. Standardization 14: 235 (Aug.

'43). Possibility of polg. safe water by faulty plumbing connections and fixtures long recognized. ASA Sectional Com. on Min. Requirements for Plumbing and Standardization of Plumbing Equip. (A40) approved air-gap stds. in July, '41 and backflow stds. in June '42. ASA approved former in Jan. '42 and latter in June '43. *Basic principles.* Std. based on extremely important principle that complete protection secured only if each outlet or fixture subject to backflow individually protected. Safest way to prevent backflow by providing safe air-gap. Backflow preventer recommended, however, only where proper air-gap not usable or subject to deliberate removal by user. Back flow preventers never to be installed on inlet side of control valve, to avoid subjection to const. water supply line pressure. *Air-gaps required.* Air-gap is unobstructed vertical distance through free atm. between lowest opening from any pipe or faucet supplying water to tank or plumbing fixture, and flood-level rim of receptacle. Purpose, in case of vacuum in pipe, to prevent intruding air from picking up from surface too close to spout. Min. air-gaps for plumbing fixtures: Lavatories, 1";

sinks, laundry trays and goose-neck bath faucets, 1.5"; over-rim bath fillers, 2". Generally, distance should be at least 2 times diam. of effective opening. If fixture wall near air-gap, increase values by 50%. If tanks or vats have special overflow of specific size and constr., such installations may have inlet pipe below tank top. Not recommended procedure; merely substitute. *Backflow preventers; design and constr.* Two gen. types permitted: (1) those depending upon one or more movable parts for proper operation; and (2) those not dependent upon moving or movable part. Important in any case is "critical level," that to which device immersible before backflow begins when tested under worst vacuum conditions. Preventers must be complete working units and have (1) sufficiently ample water passage to allow ample flow to fixture; and (2) air-inlet opening not less than 100% of nominal size of inlet to control valve. Movable part devices shall include disc or other movable unit normally in position to prevent vacuum acting on fixture contents. Air ports shall be open except during water flow. Latter force shall act on disc unit, closing air ports, and disc return to normal position without springs or other flexible, elastic materials, when flow stops. *Installation and tests.* Re-emphasized that backflow preventers never installed on inlet side of control valve, but between latter and fixture. Criti-

cal level shall be not less than 4 times nominal diam. of control valve inlet above flood-level rim of fixture; never less than 4" on closets, urinals and similar fixtures. Re tanks and vats, special provision for preventer installation below fixture top if certain rigid conditions met re overflow. For closet tanks, preventer shall be 1" or more above top of overflow opening, latter to have sufficient capac. to keep water from rising more than  $\frac{1}{4}$ " above overflow tap with tank influent 5 gpm. Principal requirement of any preventer, to keep water from rising more than 1" in outlet pipe under max. vacuum conditions. Vacuum tests to be applied definitely described and designed to simulate any possible condition occurring in water-piping system. *Gen. remarks.* Section on terms and definitions re cross-connections and backflow, important part of stds. Fixture design important but useless if installation faulty. Essential that connections to water supply system be made by those familiar with health hazards of back-siphonage and legally required to obey certain rules and regs. Authors trust that these stds. will gradually be incorporated into city and state plumbing codes, becoming part of working knowledge of plumbers and pub. health officials, thus achieving all-important goal of protecting pub. health and interest.—*Ralph E. Noble.*

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## Corner-Cutting Practices

### From Here and There

Culled from replies to the Secretary's Letter to the Membership on Feb. 21, 1945, entitled "Wartime Water Works Information"

#### Manhour-Cutting Routines

Dale L. Maffitt, General Manager of the Des Moines, Iowa, Water Works, sends to Association headquarters the following compilation of corner-cutting routines followed by his office and plant. These practices typify those engaged in by many departments, large and small, throughout the country.

1. Main laying and other new construction has been discontinued.

2. Some janitorial work, upkeep of grounds and guarding have been eliminated by not allowing visitors at the plant.

3. When the consumer is not found at home, the meter reader leaves a return post card and the consumer reads and reports his own meter.

4. Consumers are reminded of delinquent accounts by telephone rather than by a man calling personally to make the collection cut.

5. Meters in outdoor pits are read from surface by one man instead of, as formerly, by two men—one entering the pit as the other guards the opening.

6. The so-called courtesy or second notice of water bill past due has been discontinued and only first and final notices are sent out.

7. The name index has been eliminated and all accounts are listed by address only.

8. Water accounts receivable are balanced every two months instead of every month.

9. The payroll has been made up on a semi-monthly basis instead of weekly.

10. Men have been replaced with women in the laboratory; and some samples which were formerly analyzed daily are now analyzed weekly.

#### Absenteeism

A.W.W.A. Vice-President Leonard N. Thompson, General Superintendent and Engineer of the St. Paul Water Department, reports that absenteeism for sickness there has been cut by inauguration of the following system:

Initially, each monthly employee was given a sick leave credit of five days for each full year of service up to a maximum credit of 100 days. For each year following, each employee is credited with his unused sick leave for the year, with a maximum annual accumulation of twelve days, and a total maximum accumulation of 300 days.

As a result, employees now try to use as little sick leave each year as is possible, so that it may be accumulated against a future long period of illness. Cumulative sick leave is, of course, made available as required and at any time, but only after the current year's twelve days have been exhausted. Absence on cumulative sick leave requires a physician's certification.

Walter B. Bushway, Superintendent of the Brookline, Mass., Water Department, also reports on reductions in absenteeism.

"We have been successful," he writes, "in reducing the number of colds which usually have bothered our men during the winter months by installing paper drinking cup dispensers, paper towels and bubblers. On emergency night jobs we have adopted a policy of immediately setting up a lead furnace and burning coke to keep the men from becoming chilled when they are not working."

### Backfilling and Some New Meter Readers

Roger W. Esty, Superintendent of the Danvers, Mass., Water & Sewer Board, tells that under his jurisdiction a lot of work was done last year. A trenching machine and an air compressor with an air hoist on it for backfilling trenches saved many man-hours.

A handy substitute for meter readers turned up in the shape of high school boys after school hours and during vacation time. They were found to be very accurate and very quick and are reported to "do as well as, if not better than, some . . . regular meter readers."

### Gasoline Shovel

The Butte, Mont., Water Co., of which Wade Plummer is general manager, is cutting corners by the use of a gasoline shovel. Plummer reports that, though no exact estimates have been made, it is believed that the unit does the work of from five to twenty men, depending on the job. No night watchman is required, as the shovel is brought to the garage every night. The regular water department employees have learned to operate it, thus making it usable at all times. The unit cost \$9,500.

The machine is a "Michigan Truck Shovel," of  $\frac{3}{4}$ -yd. capacity, with shovel, trench hoe and 30-ft. crane attachments. It takes two hours to change from shovel to trench hoe, and vice versa. The gasoline shovel is mounted on pneumatic tires and has a road speed of about 25 mph., thus affording high mobility. It is used in trenching, backfilling, pipe laying, snow removal, road building, reservoir cleaning (crane), lifting of concrete, pile driving and numerous other jobs.

### Meter Readers' Code

The meter readers at the Indianapolis, Ind., Water Co. save time by using their own shorthand. Some of their code symbols are:

O.S.E. ....	Outside Entrance
N.S.D. ....	North Side Door
S.S.D. ....	South Side Door
N.S.P. ....	New Style Pit
O.S.P. ....	Old Style Pit
P.T. ....	Porch Trap Door
K.T. ....	Kitchen Trap Door
D.R.E. ....	Dining Room East
F.D. ....	Call at Front Door
Dog O.K. ....	Dog will not bite
P. Ent. ....	Porch Entrance
2X ....	Second House
Key in Office ....	Same
Through Garage ..	Same
Key X N ....	Get key first house north
Key 2X S ....	Get key second house south
P.K. O.K. ....	Tenants have given permission for meter readers to use pass key

The meter reading sheet used at the Indianapolis Water Co. bears a square block indicating the house and a straight line indicating the sidewalk. On this outline diagram the reader marks the location of the meter on each property.